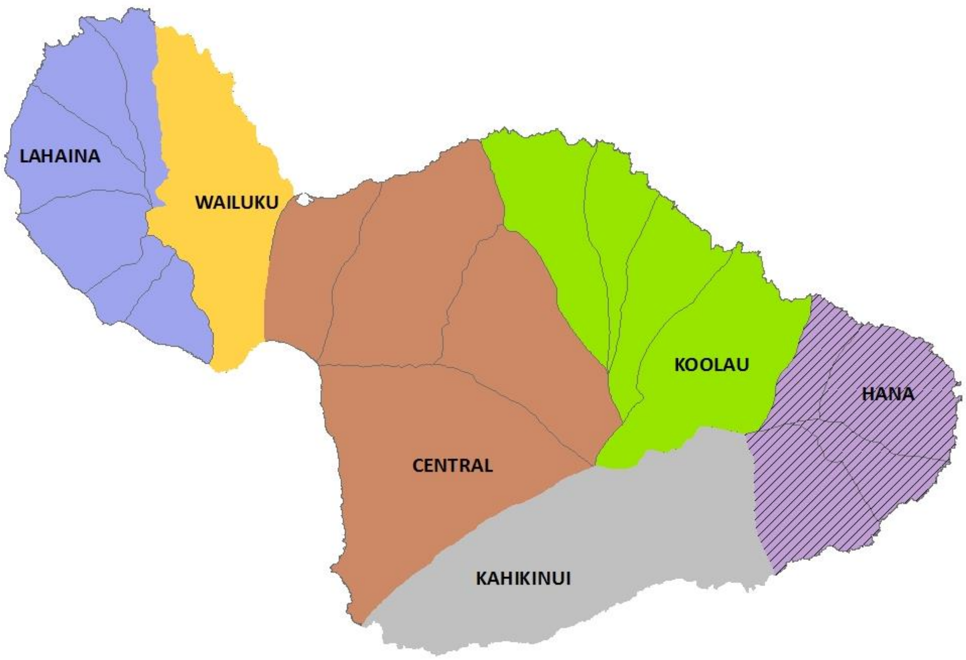


MAUI ISLAND WATER USE AND DEVELOPMENT PLAN DRAFT

PART III REGIONAL PLANS

HĀNA AQUIFER SECTOR AREA

Table of Contents

17.0 HĀNA AQUIFER SECTOR AREA

The Hāna Aquifer Sector Area (ASEA) encompasses about 89 square miles, including four groundwater Aquifer System Areas (ASYAs): Kipahulu, Waiho`i, Kawaipapa, and Kūhiwa underlying both the eastern and southern flanks of the eastern tip of Haleakalā. The 2015 population of the Hāna Community Plan area was 2,408 residents (includes some outlying areas within the Ko`olau and Kahikinui ASEAs), and is projected by the Maui Island Plan to increase by 22 percent to 2,938 residents by 2035.[1] The WUDP uses hydrologic units for presentation and analysis consistent with state requirements for updating the plan; however, the geographic areas of the Hāna Community Plan and moku boundaries differ from the Commission on Water Resource Management's (CWRM) aquifer sectors in the following ways: (1) the Hāna Community Plan also includes portions of the adjacent Ko`olau ASEA and most of Kahikinui ASEA; and (2) it encompasses all or portions of various moku (Ko`olau, Hāna, Kīpahulu, Kaupō, Kahikinui, and Hāmākualoa) and their underlying ahupua`a.

[1] County of Maui, Final Draft Socio-Economic Forecast, Maui County Planning Department, Long Range Planning Division, 2014.

17.1 PLANNING FRAMEWORK

17.1.1 Key Issues

Open public meetings and workshops during 2016 identified key issues and concerns for the Hāna region. Many of the issues raised pertain to stream diversions from the Ko`olau aquifer sector transmitted to Central Maui. Other issues and concerns relate to the leeward Kaupō and Kahikinui areas. These issues are addressed in the Ko`olau and Kahikinui aquifer sector reports respectively. While overlapping, key issues identified for the Hāna community and water resources within the Hāna aquifer sector relate to watershed management and participation by the local community; maintenance of traditional resource management using the ahupua`a system and ensuring that traditional and customary practices are safe guarded. Community members state that younger generations are returning to Hāna to establish taro lo`i. Projected public water use is relatively modest even with an anticipated 22 percent increase in population growth for the Hāna Community Plan Area.[2] A key issue for the region is providing affordable water for future needs, providing for taro lo'i and other public trust uses during droughts, and managing resources in a sustainable way. Region specific input received at community meetings, via surveys and at a policy board meetings generally focused on the following issues:

- Watershed protection and its prioritization, including invasive alien plant control, ungulate control, and reforestation via watershed partnership programs
- Maintaining access to lands for gathering, hunting and other native Hawaiian traditional and customary practices
- Improving the understanding of the concepts of "precautionary planning" to reduce and adapt to the effects of drought and climate change upon water resource availability and quality
- Adapting future populations to local water resource conditions, integrating conservation and the use of alternative resources
- Water needs of DHHL in Hāna should be considered in general and in accordance with the 2017 State Water Projects Plan
- Consultation and coordination with Native Hawaiian community/moku and local experts on resource management and invasive species removal

17.1.2 Plans, Goals, Objectives and Policies

The Hāna ASEA implements the Maui County General Plan and is subject to the plans, goals, policies and objectives discussed in Chapter 3 of the WUDP. The Maui Island Plan does not identify goals, objectives and policies that are specific to Hāna but rather island-wide. All goals and objectives adopted in Chapter 6.3 of the MIP are consistent with the broad planning objectives of the WUDP as shown in the matrix of WUDP Part I, Appendix 2 *"County Plan Policy and Programs Relevant to the WUDP, and Consistency with the Planning Objectives".*

[2] Ibid.

The 1994 Hāna Community Plan

The 1994 Hāna Community Plan reflects regional issues expressed at the community meetings for the WUDP. Community plan goals and policies related to water resources and use are summarized below.

Water Resources

Goal:

Protection and management of land, water and ocean resources

Objectives and Policies

- Protect, preserve and increase natural marine, coastal and inland resources, encouraging comprehensive resource management programs
- Recognize residents' traditional uses of the region's natural resources, which balance environmental protection and self-sufficiency
- Discourage water or land development and activities which degrade the region's existing surface and groundwater quality
- Encourage resource management programs that maintain and re-establish indigenous and endemic flora and fauna
- Protect, restore and preserve native aquatic habitats and resources within and along streams
- Ensure that groundwater and surface water resources are preserved and maintained at capacities and levels to meet the current and future domestic, agricultural, commercial, ecological and traditional cultural demands of each area in the Hāna District

Water Availability and Use

Goal:

Timely and environmentally sensitive development and maintenance of infrastructure systems, including the provision of domestic water

Objectives and Policies

- Improve water source and delivery facilities to ensure that water supplied to the region's residents and visitors is of the highest quality
- Identify water service area expansion needs in the Hāna region
- Encourage water conservation measures by residents and businesses

17.2 Physical Setting

17.2.1 Climate and Geology

Hāna is located on the younger of Maui Island's two mountain ranges on the East Maui Volcano known as Haleakalā. The volcanism of the area is considered dormant.[3] The rainy eastern slope where the Hāna Aquifer Sector Area (ASEA) is located has valleys that are separated by broad areas and ridges.[4] At middle and lower altitudes of Haleakalā, forests cover much of the wet windward slopes.[5] The lush tropical growth and deep erosion along the Hāna coastline contrast vividly with Haleakalā's dry southwest shore. Most of Hāna's lower areas consist of seacoast cloaked in tropical forest. Mountains obstruct trade-wind air flow and create wetter climates on north- and northeast-facing (windward) mountain slopes where much of Hāna is positioned.[6] Persistent trade winds and orographic lifting of moist air result in recurrent clouds and frequent rainfall on windward slopes and near the peaks of all but the tallest mountains of the Hawaiian Islands.[7] When trade winds are present, the vertical development of clouds is restricted by the trade-wind inversion layer. The altitude of the inversion, however, varies over time and space and is affected by thermal circulation patterns, such as land and sea breezes.[8] Most of Maui is usually immersed in the moist air layer below the inversion. On Haleakalā, mean rainfall exceeds 200 inches per year on mid-altitude windward slopes. Rainfall ranges from 60-400 inches per year in Hāna, with the annual average exceeding 300 inches (7,600 mm) along the lower windward slopes. [9] Hāna is home to some of the wettest places on Earth. At the Big Bog rain gage at 5,400 ft altitude on windward Haleakalā, mean rainfall is about 404 inches per year, which is among the highest values in the Hawaiian Islands during 1978–2007.[10]

The only road in and out of Hāna, Highway 360, winds past changing landscapes mostly consisting of tropical rainforests perched upon intensely steep cliffs. On at least four occasions,

[3] Macdonald, G.A., Abbott, A.T., and Peterson, F.L., 1983, Volcanoes in the sea (2d ed.): Honolulu, Hawaiʻi, University of Hawaiʻi Press, page 517.
[4] Johnson, A.G., Engott, J.A., and Bassiouni, Maoya, 2014, Spatially distributed groundwater recharge estimated using a water-budget model for the Island of Maui, Hawaiʻi, 1978–2007: U.S. Geological Survey Scientific Investigations Report 2014–5168, 53 p., http://dx.doi.org/10.3133/sir20145168.
[5] Ibid, page 7.
[6] Sanderson, Marie, 1993, Introduction, chap. 1 *of* Sanderson, Marie, ed., Prevailing trade winds: Honolulu, Hawaiʻi, University of Hawaiʻi Press, page 1–11.
[7] Giambelluca, T.W., Nullet, M.A., and Schroeder, T.A., 1986, Rainfall atlas of Hawaiʻi: Hawaiʻi Department of Land and Natural Resources, Division of Water and Land Development Report R76, page 267
[8] Giambelluca, T.W., and Nullet, Dennis, 1991, Influence of the trade-wind inversion on the climate of a leeward mountain slope in Hawai`i: Climate Research, v. 1, p. 207–216.
[9] Johnson, A.G., Engott, J.A., and Bassiouni, Maoya, 2014, Spatially distributed groundwater recharge estimated using a water-budget model for the Island of Maui, Hawaiʻi, 1978–2007: U.S. Geological Survey Scientific Investigations Report 2014–5168, 53 p., http://dx.doi.org/10.3133/sir20145168.
[10] Giambelluca, T.W., Chen, Q., Frazier, A.G., Price, J.P., Chen, Y.-L., Chu, P.-S., Eischeid, J.K., and Delparte, D.M., 2013, Online Rainfall Atlas of Hawaiʻi: Bulletin of the American Meteorological Society v. 94, p. 313–316, doi: 10.1175/BAMS-D-11-00228.1, at *http://rainfall.geography.Hawai`i.edu/*.

fluid Hāna lava flows followed Ke`anae Valley to the coast, with the youngest flow, 10,000 years ago, having built most of the modern Ke`anae Peninsula. The landscape changes near milepost 24, where the road passes Haleakalā's east rift zone. Dozens of cinder cones and lava flows of Hāna and Kula basalt create a terrain hundreds of thousands of years younger than the one on older volcanic rocks.[11] Upslope at mid-elevations in north Hāna, relatively recent lava flows (within the last 15,000 years) have created a rugged terrain lacking perennial streams and wet taro terraces. However, dry land taro is abundant due to the combination of humus and eroded lava frequently watered by rainfall, except during occasional droughts.

17.2.2 Water Resources

Climate, hydrology, geology and human activities affect the hydrologic cycle and the surface and ground water systems which are interconnected. Perennial and intermittent streams on windward Haleakalā are generally fed by abundant rainfall and groundwater discharge.[12] Hydrologic data is limited for ground and surface water resources in the aquifer sector. Sustainable yield for aquifer systems adopted by CWRM in 2008 are deemed reasonable for planning purposes until more detailed geologic and hydrologic information is available.[13] Select portions of the groundwater aquifer systems have been studies. Hydrologic reconnaissance in the Kipahulu Valley reported perched water in saturated zones above basal water, emerging as springs and seeps along the streams and the shoreline.[14] Occurrence of groundwater in the Hānawi watershed in Nahiku was evaluated extensively as well as groundwater occurrence and contribution to stream flow from Maliko Gulch in the west to Makapipi stream in the east. However, both study areas are regionally located outside the Hāna ASEA, in the adjacent Ko`olau ASEA.

Similarly, stream flow has been extensively assessed in the Ko`olau aquifer sector but there is little data and few gages to quantify stream flow in the Hāna ASEA.

<u>Groundwater Recharge</u>

Groundwater recharge describes the amount of water that travels from the air, through the soil, and ultimately into the groundwater and aquifers. The 2014 USGS study, *Spatially Distributed Groundwater Recharge Estimated Using A Water-Budget Model For The Island of Maui, Hawaiʻi, 1978–2007*, reassessed average climate conditions on recharge using 2010 land cover. For this study, direct recharge was defined as water that passes directly to the groundwater system, completely bypassing the plant-root zone. Hence, direct recharge was not

---

[11] Hazlett, Richard W. and Hyndman, Donald W., *Roadside Geology of Hawai'i*, page 129.

[12] Gingerich, S.B., 1999a, Ground water and surface water in the Haiku area, East Maui, Hawai`i: U.S. Geological Survey Water-Resources Investigations Report 98–4142, 38 p.

13 Gingerich, S.B., 1999b, Ground-water occurrence and contribution to streamflow, northeast Maui, Hawai`i: U.S. Geological Survey Water-Resources Investigations Report 99–4090, 69 p.

[13] Commission on Water Resource Management, Water Resources Protection Plan 2008 page 3-87

[14] Souza, William. U.S.Geological Survey. Exploratory Drilling and Aquifer Testing at the Kipahulu District, Haleakala National Park, Maui , Hawaii. 1983 Report 83-4066

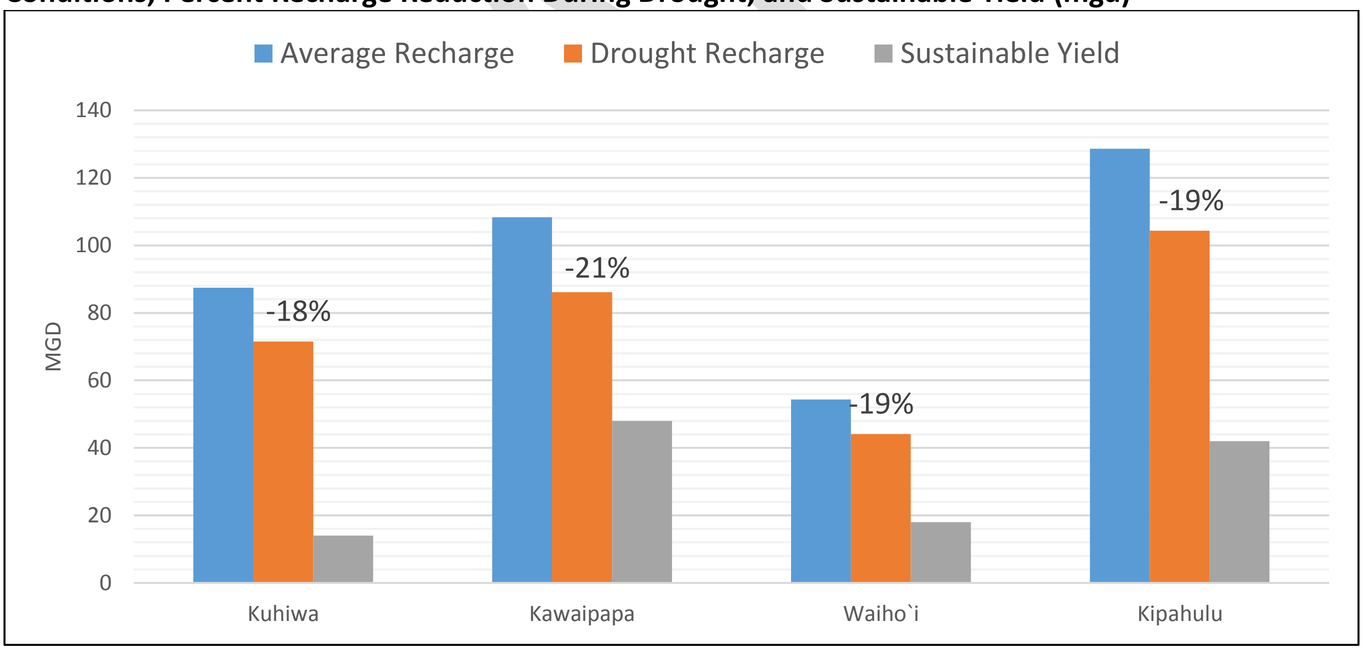
subject to direct runoff or evapotranspiration processes.[15] In 2017, USGS discovered an error in data that affected published groundwater-recharge estimates for Maui and other islands. The recharge estimated for 1978 – 2007 rainfall and 2010 land-use conditions were revised and made available for reference, pending publication of a revised report. The corrected data is reflected in the table and chart below. Of Maui's total mean recharge for average climate conditions, 60 percent occurs in the Ko`olau and Hāna ASEA's on windward Haleakalā.[16] A drought condition scenario modeled for the Hāna ASEA based on rainfall during the 1998–2002 period yielded a 19 percent reduction in recharge sector-wide, compared to average climate conditions.

Table 17-1 Hāna ASEA Groundwater Recharge Estimates Drought and Average Conditions

Recharge Average Climate Conditions (mgd)	Recharge Drought Climate Conditions (mgd)	% Decrease Drought Climate Conditions
379	306	19

Source: Spatially Distributed Groundwater Recharge Estimated Using A Water-Budget Model For The Island of Maui, Hawaiʻi, 1978–2007.

Figure: 17-1 Hāna ASEA Average Mean Recharge under Average Climate and Drought Conditions, Percent Recharge Reduction During Drought, and Sustainable Yield (mgd)



Source: CWRM 2008 Sustainable Yields; USGS, *Spatially Distributed Groundwater Recharge Estimated Using A Water-Budget Model For The Island of Maui, Hawai`i, 1978–2007.*

[15] Johnson, A.G., Engott, J.A., and Bassiouni, Maoya, 2014, Spatially distributed groundwater recharge estimated using a water-budget model for the Island of Maui, Hawaiʻi, 1978–2007: U.S. Geological Survey Scientific Investigations Report 2014–5168, 30 p., http://dx.doi.org/10.3133/sir20145168.

[16] Ibid 49 p.,

The Pacific Regional Integrated Sciences and Assessments' (Pacific RISA) *Maui Groundwater Project* is an interdisciplinary research effort to inform decisions about the sustainability of groundwater resources on the island of Maui under future climate conditions. A new hydrologic model is being used to assess the impact of changing climate and land cover on groundwater recharge over the island. Preliminarily future climate projections for Maui island suggest that wet areas get wetter with mean annual rainfall increases. Scientists' confidence in trends and changes to rainfall and associated recharge is relatively low. No stream flow projections are available for the coming century. The impact on recharge and stream flow from climatic changes is at the time of this plan highly uncertain.

Groundwater Availability

The groundwater sustainable yield (SY) is the maximum rate that groundwater can be withdrawn without impairing the water source as determined by the Commission on Water Resources Management (CWRM). The 2008 sustainable yield for the Hāna aquifer sectors and aquifer systems shown below is 122 mgd: (1) Kūhiwa = 14 mgd; (2) Kawaipapa = 48 mgd; (3) Waiho`i = 18 mgd; and (4) Kipahulu = 42 mgd. Generally, SY is conservatively set at the low end of the estimated range of predicted sustainable yields for an aquifer. Updated SY for the entire state is under review for the pending 2017 State Water Resource Protection Plan.

Table 17-2 Sustainable Yields for Hāna Aquifer System Areas (ASYAs)

Hāna Aquifer System Area (ASYA)	Aquifer Code	Sustainable Yield Range	2008 WRPP Sustainable Yield (mgd)
Kūhiwa	60501	14*	14
Kawaipapa	60502	48*	48
Waiho`i	60503	18-21	18
Kipahulu	60504	42*	42

Source: CWRM, *State Water Resource Protection Plan*, June 2008, page 3-66.
*No range given for this

CWRM ranks the SY values according to the degree of confidence that CWRM places on the number, ranging from (1) most confident to (3) least confident. The degree of confidence is directly related to the type, quality and quantity of hydrologic data used in the SY determination. As noted previously, there are few hydrologic studies done for the aquifer systems within the Hāna sector. CWRM ranked all aquifer systems in this sector (3) least confident, recognizing that there is significant uncertainty associated with the SY due to the lack of hydrogeologic and pumpage information.[17]

[17] CWRM, Water Resources Protection Plan, 2008 pp 3-82

Sustainable yield does not include water transfers, such as irrigation return flow. Groundwater for municipal services is developed in Kawaipapa aquifer and transmitted within Kawaipapa and south to Waiho`i aquifer. Planned growth areas within Country Town and Rural Growth Boundaries and proposed development projects are confined to these aquifer systems. Surface water is generally not transported between aquifer systems in the Hāna sector, except for limited diversions of Manawainui stream at the eastern most boundary of Kipahulu aquifer system and Nahiku Tunnel by Makapipi Stream on the boundary of Kuhiwa aquifer and Keanae aquifer in the adjacent Ko`olau ASEA. The graphic below shows the relationship between aquifer systems, watersheds, streams, moku, Maui Island Plan growth boundaries and development projects.

Figure 17-2 Hāna ASEA Relationship of Aquifer System Areas and Sustainable Yield to Maui Island Plan Growth Boundaries and Development Projects

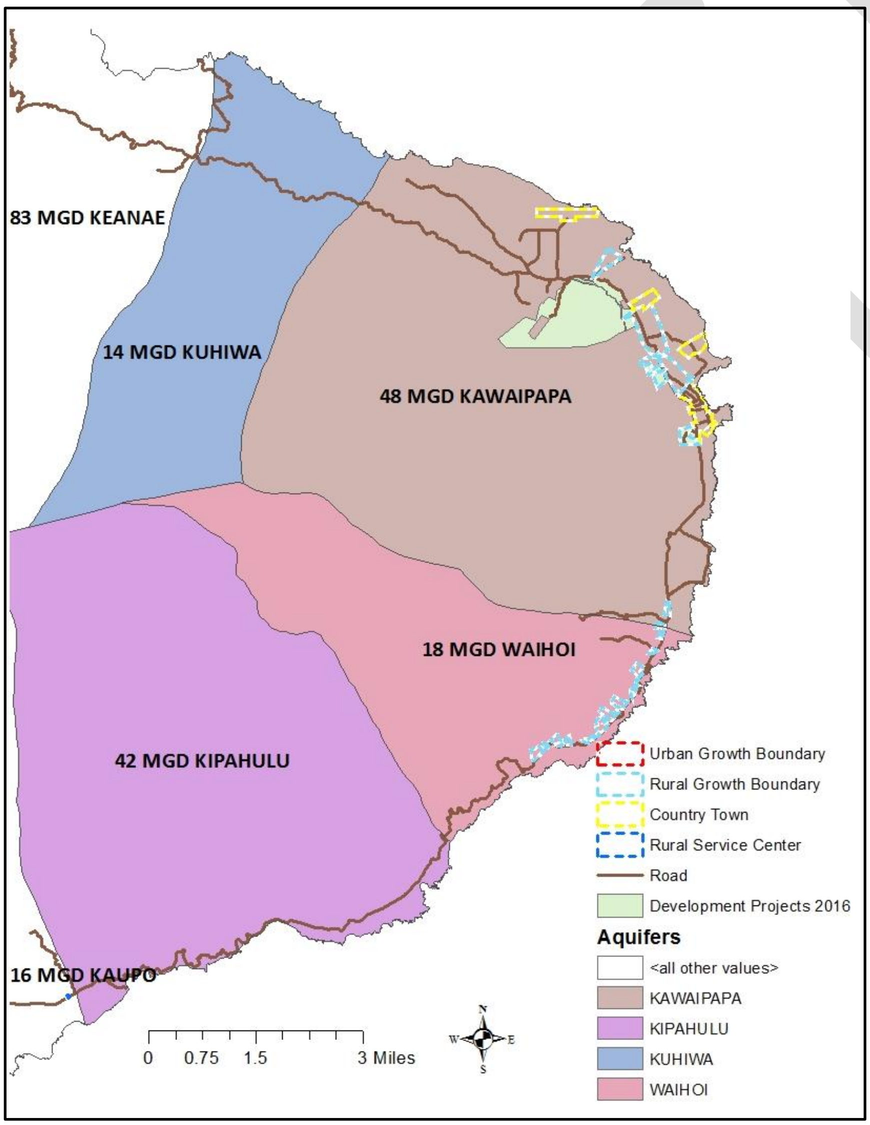
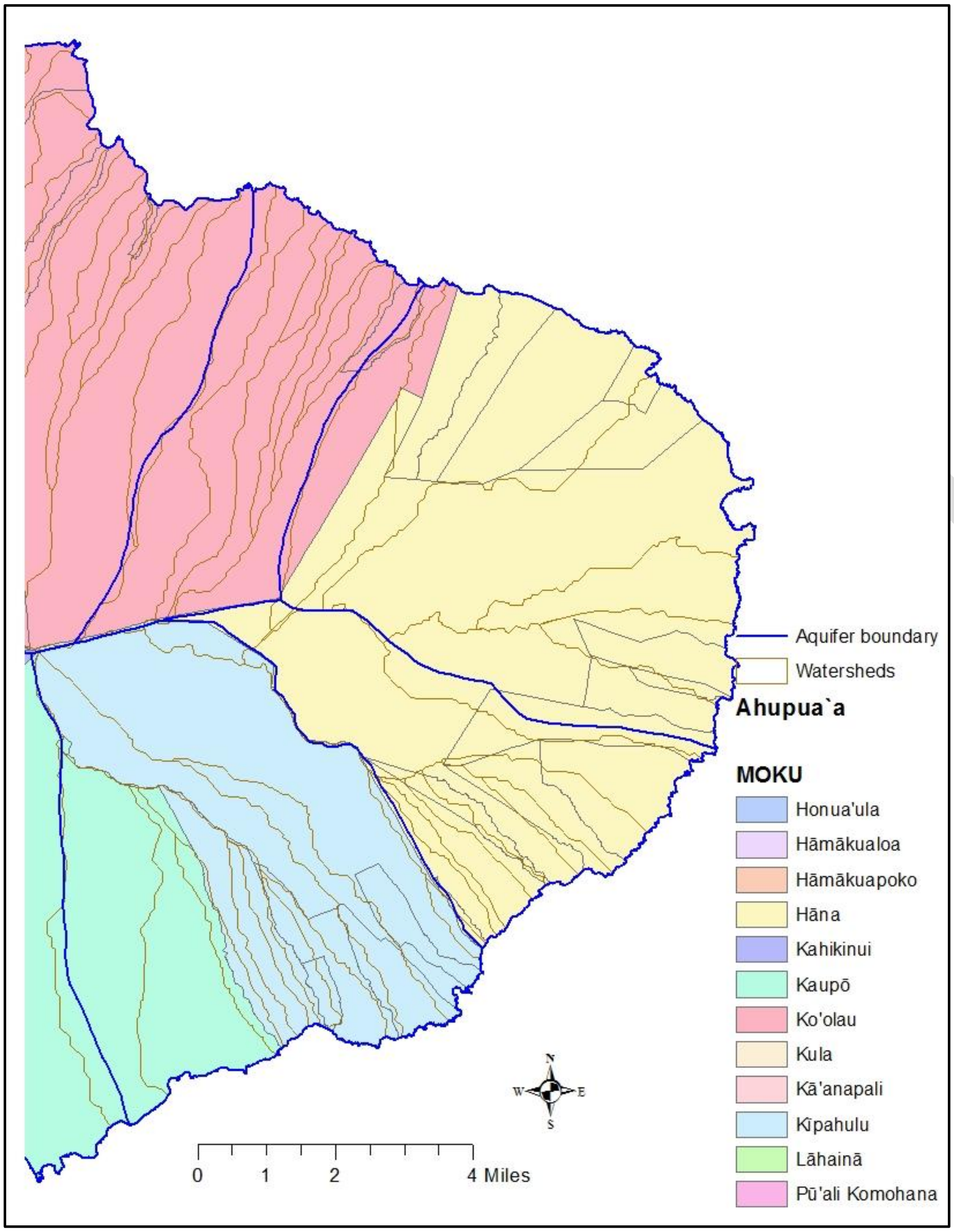


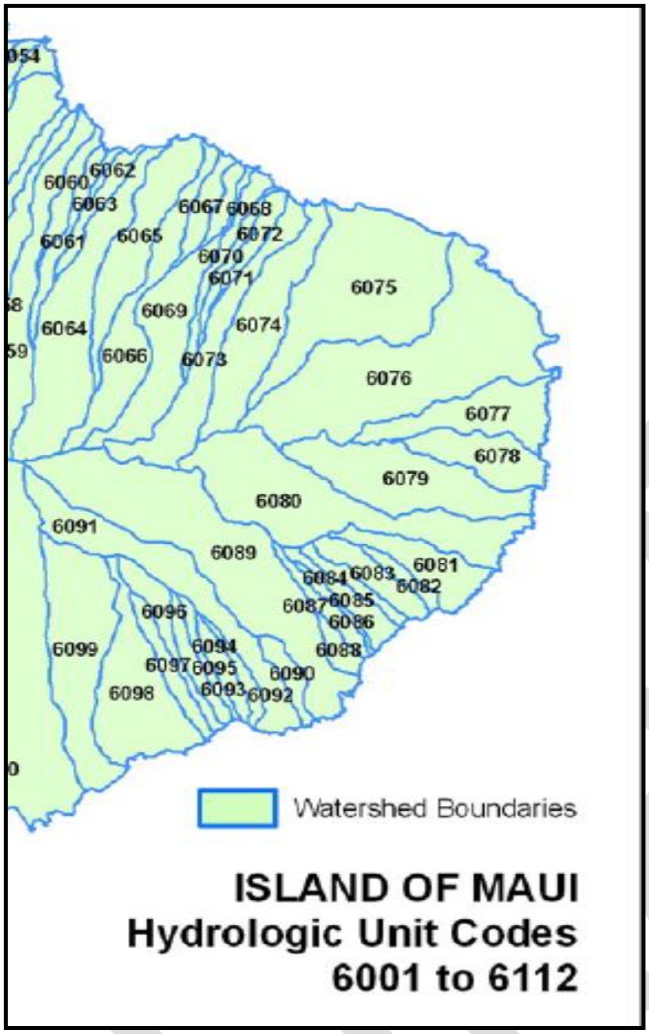
Figure 17-3 Hāna ASEA Relationship of Aquifer System Areas, Watersheds, and Moku



Surface Water Availability

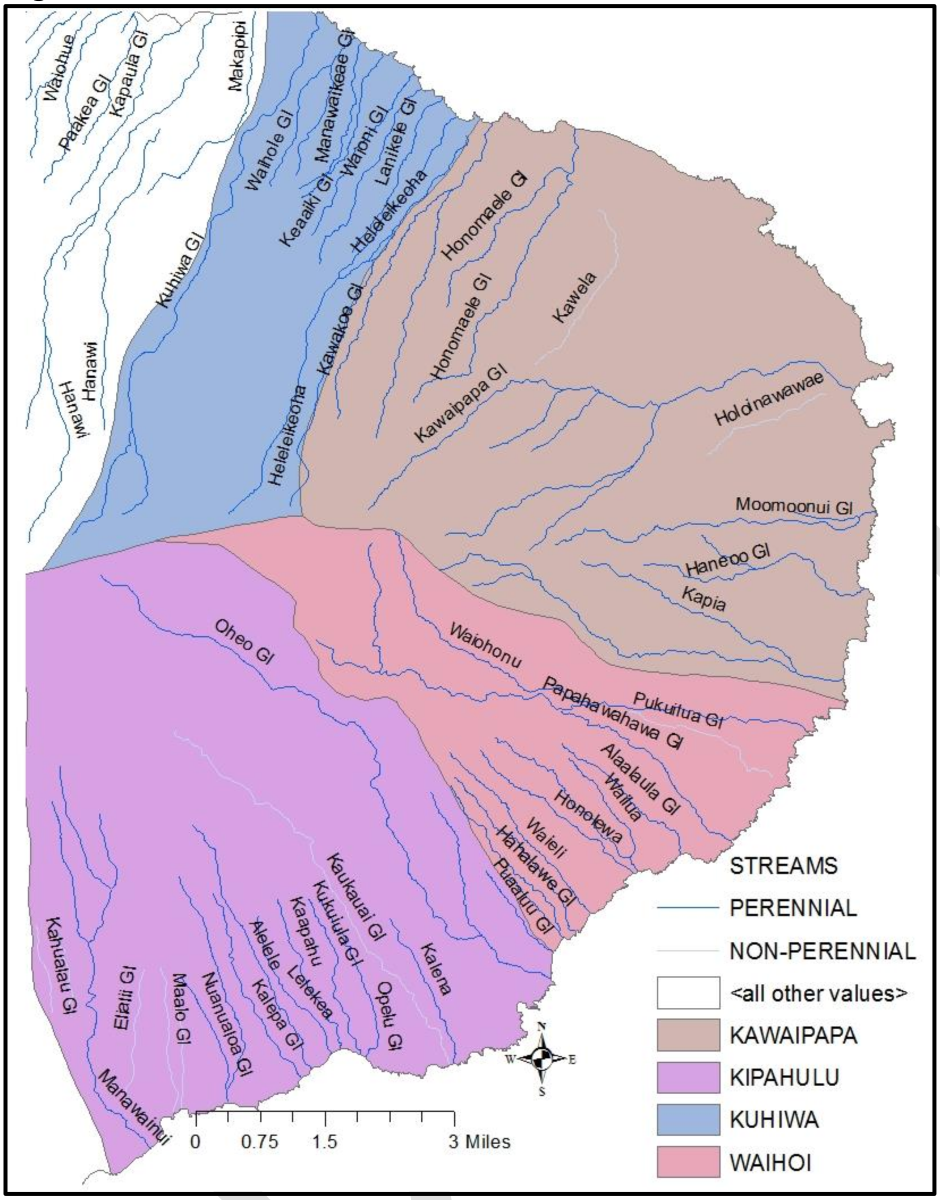
The surface water hydrologic units, generally referred to as watersheds, are shown below primarily for reference purposes. There are 34 surface water units (watershed units) and 25 perennial streams within the area encompassed by the Hāna ASEA.

Figure 17-4 Hāna ASEA Hydrological Units/Watersheds



Unit Code	Hydrologic Unit Name
6066	Kuhiwa
6067	Waihole
6068	Manawaikeae
6069	Kahawaihapapa
6070	Keaaiki
6071	Waioni
6072	Lanikele
6073	Heleleikeoha
6074	Kawakoe
6-4-33	Ulaino
6076	Kawaipapa
6-4-36	Unnamed
6077	Mo\`omo\`onui
6078	Haneo\`o
6079	Kapia
6080	Waiohonu
6081	Papahawahawa
6082	Ala\`alaula
6083	Wailua
6084	Honolewa
6085	Waieli
6086	Kakiweka
6087	Hahalawe
6088	Puaalu\`u
6089	Oheo
6091	Koukouai
6092	Opelu
6093	Kukuiula
6094	Kaapahu
6095	Lelekea
6096	Alelele
6097	Kalepa
6098	Nuanua\`aloa
6099	Manawainui

Figure 17-5 Hāna ASEA Perennial and Non Perennial Streams



Source: Hawai`i Stream Assessment, Report R84, December 1990.

There are 70 declared stream diversions on 21 streams according to the CWRM database and 9 gages, of which, only one is "active" (Oheo). The following table shows the number of diversions and gages for Hāna ASEA streams and the interim instream flow standards (IIFS). The IIFS in the region reflects the diverted amounts existing at the time when the status quo IIFS were adopted in 1988. [18]

[18] Hawai`i Administrative Rules, Section 13-169-46, "Interim Instream Flow Standard for all streams on Hawai`i, as adopted by the commission on water resource management on June 15, 1988, shall be that amount of water flowing in each stream on the effective date of this standard, and as that flow may naturally vary throughout the year and from year to year without further amounts of water being diverted offstream through new or expanded

Table 17-3 Hāna Stream Diversions, Gages and IIFS by Watershed Unit

Aquifer System	Code Unit	Hydrologic Unit	Area (mi²)	No. of Diversions	No. of Gages	Interim IFS
Kuhiwa	6066	Kuhiwa	3.41	0	0	HAR §13-169-44
Kuhiwa	6067	Waihole	0.88	2	0	HAR §13-169-44
Kuhiwa	6068	Manawaikeae	0.52	0	0	HAR §13-169-44
Kuhiwa	6069	Kahawaihapapa	3.73	0	0	HAR §13-169-44
Kuhiwa	6070	Keaaiki	1.03	2	0	HAR §13-169-44
Kuhiwa	6071	Waioni	0.63	2	0	HAR §13-169-44
Kuhiwa	6072	Lanikele	0.7	1	0	HAR §13-169-44
Kuhiwa	6073	Heleleikeoha	3.48	14	0	HAR §13-169-44
Kawaipapa	6074	Kawakoe	4.04	15	0	HAR §13-169-44
Kawaipapa	6075	Honomaele	7.94	4	1	HAR §13-169-44
Kawaipapa	6076	Kawaipapa	10.7	0	2	HAR §13-169-44
Kawaipapa	6077	Mo`omo`onui	2.95	0	1	HAR §13-169-44
Kawaipapa	6078	Haneo`o	2.13	0	0	HAR §13-169-44
Kawaipapa	6079	Kapia	4.71	3	0	HAR §13-169-44
Waiho`i	6080	Waiohonu	7.15	0	1	HAR §13-169-44
Waiho`i	6081	Papahawahawa	1.96	0	0	HAR §13-169-44
Waiho`i	6082	Ala`alaula	0.48	2	0	HAR §13-169-44
Waiho`i	6083	Wailua	1.26	4	0	HAR §13-169-44
Waiho`i	6084	Honolewa	0.63	1	0	HAR §13-169-44
Waiho`i	6085	Waieli	0.96	0	0	HAR §13-169-44
Waiho`i	6086	Kakiweka	0.34	1	0	HAR §13-169-44
Waiho`i	6087	Hahalawe	0.74	1	1	HAR §13-169-44
Kipahulu	6088	Pua`alu`u	0.53	4	0	HAR §13-169-44
Kipahulu	6089	Oheo	9.7	0	2	HAR §13-169-44
Kipahulu	6090	Kalena	0.71	1	0	HAR §13-169-44
Kipahulu	6091	Koukouai	4.56	2	0	HAR §13-169-44
Kipahulu	6092	Opelu	0.53	2	0	HAR §13-169-44
Kipahulu	6093	Kukuiula	0.74	1	1	HAR §13-169-44
Kipahulu	6094	Ka`apahu	0.5	0	0	HAR §13-169-44
Kipahulu	6095	Lelekea	0.78	0	0	HAR §13-169-44
Kipahulu	6096	Alelele	1.2	0	0	HAR §13-169-44
Kipahulu	6097	Kalepa	0.97	2	0	HAR §13-169-44
Kipahulu	6098	Nuanua`aloa	4.24	3	0	HAR §13-169-44
Kipahulu	6099	Manawainui	5.17	3	0	HAR §13-169-44

Source: CWRM, *State Water Resources Protection Plan*, 2008.

---

diversions, and under the stream conditions existing on the effective date of the standard, except as may be modified [by the commission."

The 1990 Hawaii Stream Assessment prepared for CWRM inventoried streams state wide. However, data on stream flow is only available through either active gages or stream assessment and studies. With one known active gage, information on stream flow under various conditions is extremely limited. Where no stream flow data is available, declaration of water use and kuleana parcels can provide some guidance to water availability. The table below shows registered or permitted diversions, available stream flow data, water use declarations and reported kuleana parcels in the pertaining hydrologic unit.

Table 17-4 Hāna Surface Water Units, Natural Streamflow, Diversions, 1989 Declarations of Water Use, and known Kuleana Parcels

Unit Code	Hydrologic Unit Name	Lowest Median Flow (Q50)	No. of Divers ions	Lowest Q70 Flow	1989 Dec. of Water Use (mgd)	Kuleana parcels (OHA 2009 GIS)
6066	Kuhiwa		0		0	
6067	Waihole		2		0.001	
6068	Manawaikeae		0		0	
6069	Kahawaihapapa		0		0	Kahawaihapapa, but not adjacent to stream
6070	Keaaiki		2		0	
6071	Waioni		2		0	
6072	Lanikele		1		0	
6073	Heleleikeoha		14		0.001	
6074	Kawakoe		15		0.002	
6075	Honomaele		4		0	
6076	Kawaipapa		0		0	
6077	Mo`omo`onui		0		0	Mo`omo`onui
6078	Haneo`o		0		0	Haneo`o
6079	Kapia		3		0.002	
6080	Waiohonu		0		0	Waiohonu, Pukuilua
6081	Papahawahawa		0		0	
6082	Ala`alaula		2		0.007	
6083	Wailua		4		0.101**	Wailua
6084	Honolewa		1		0	Honolewa
6085	Waieli		0		0	
6086	Kakiweka		1		0	
6087	Hahalawe		1		0	
6088	Puaalu`u		4		0.112	
6089	Oheo	3.68	0	0.00	0	Oheo

6090	Kalena		1		0	
6091	Koukouai		2		0	
6092	Opelu		2		0	
6093	Kukuiula		1		0	
6094	Ka`apahu		0		0	
6095	Lelekea		0		0	
6096	Alelele		0		0	
6097	Kalepa		2		0.018	
6098	Nuanua`aloa		3		0	Nuanua`aloa
6099	Manawainui		3		0.004*	
Total		**3.68**	**71**		**0.143**	

Source: Diversions, Declared Use 1989, Reported Water Diverted 2011-2015: CWRM Reports. Discharges (Q figures): USGS Scientific Investigations Report 2016-5103. Kuleana parcels: based on Office of Hawaiian Affairs GIS data, 2009.
*The water use declaration from the Manawainui stream is used to provide non-potable surface water to the Kaupo community within the Kahikinui ASEA. Therefore, it is not counted as water use for the Hāna ASEA analysis.
**Previously declared diversion from MDWS. No longer in use. Not included in total.

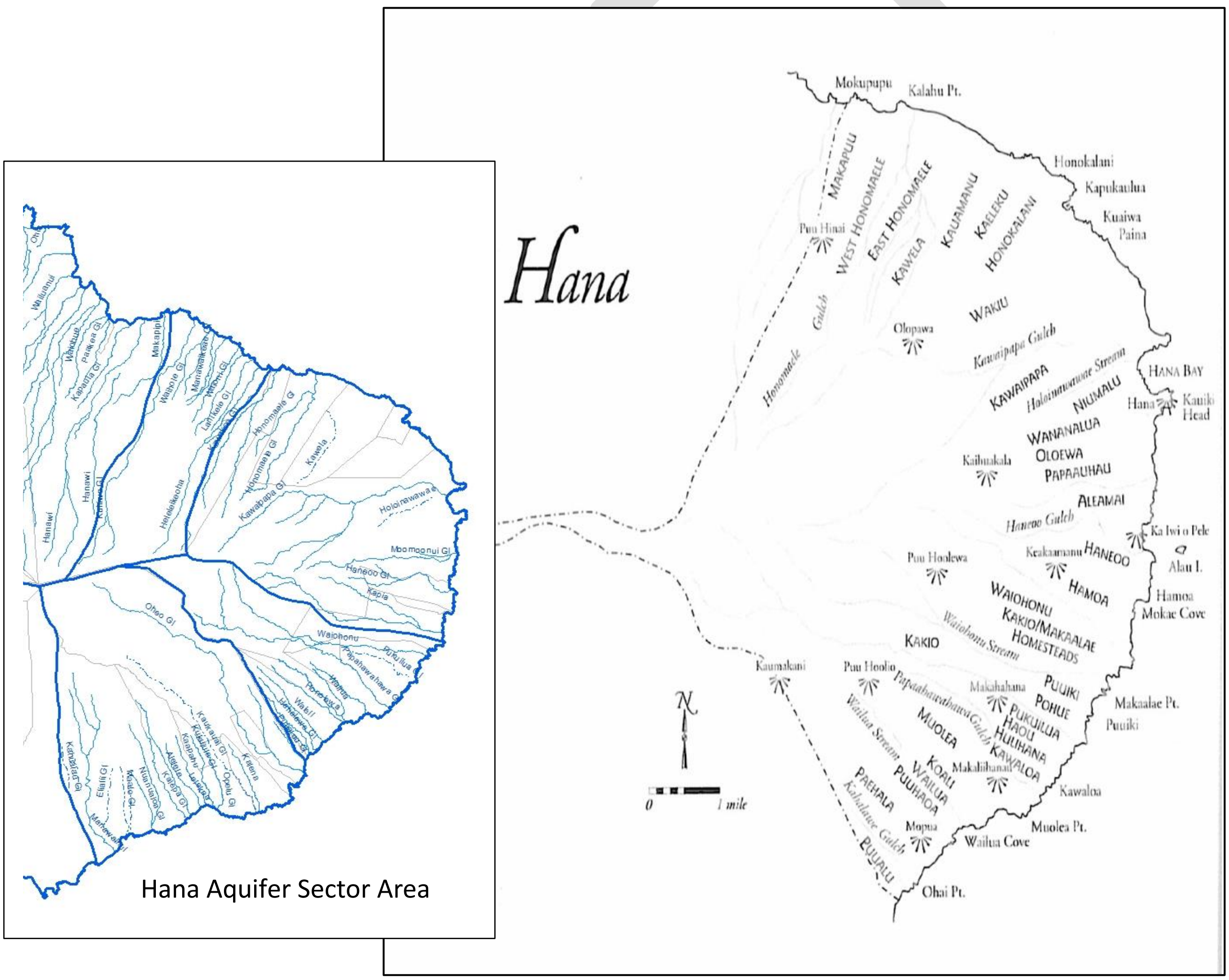
Transport of Stream Water from East Maui

Streams in the Ko`olau ASEA, bordering Kuhiwa aquifer system to the west, is subject to the East Maui Contested Case due to significant diversions by East Maui Irrigation Company (EMI) to Central Maui. Although EMI and its parent company Alexander & Baldiwn Inc. own water lease licensed areas located in Nahiku, there is presently no conveyance infrastructure to move water from the Hāna ASEA to the Ko`olau ASEA for use in Central and Upcountry Maui water systems.

17.3 SETTLEMENT PATTERNS AND CULTURAL RESOURCES

This section strives to acknowledge and highlight how Hawaiian history and cultural practices of the past relate to the present, and can inform options for meeting the future water needs of the people and uses of Maui Island while preserving and celebrating Hawai`i's past. Archaeology and traditional Native Hawaiian historical and cultural information provide a foundation for establishing continuity between past, present and future water use in the Hāna area. The traditional area of Hāna includes the districts of Kaupō, Kipahulu, Hāna, and Nahiku, which contrast with the boundaries of the Hāna Aquifer Sector Area (ASEA) used by the WUDP, which do not include Nahiku and Kaupō.

Figure 17-6 Hāna Region and Hāna Aquifer Sector



Source: Sterling, Elspeth P. *Sites of Maui.* Bishop Museum Press, 1997.

Historical Context

Hāna is steeped in legend and was a major center of population and political power in ancient Hawai`i. Plantation sugar was cultivated here through the mid-twentieth century, destroying many traditional structures. The ruggedness of the land and the persistence of a large Hawaiian population have contributed to significant preservation efforts. Some of the most intact and extensive native forests left in Hawai`i today occur in the East Maui watershed.[19] Hāna has 32 recorded heiau (temples), including Pi`ilani Hale, the largest heiau in the state.[20]

In ancient times Hāna was well known for an abundance of water, food and people. Hawaiian history prior to European contact can be interpreted though the archaeological record, whose vast walls, fishponds, village foundations, and heiau tell of populations that far exceeded those of today in remote areas such as Hāna. Because Pi`ilanihale Heiau is located in Hāna, this suggests that a comparatively large population would have evolved at that sacred site and the surrounding areas.

Phrase of Hāna

Today, as one enters the Hāna district, signs along the Hāna Highway still proclaim Hāna to be "Ka 'Aina o Ka Ua Kea," the land of the white misty rain, for the mists that blanket the district day and night.

Agriculture

<u>Historical Native Hawaiian Agriculture and Cultural Resources</u>

Hāna is known for its historical agricultural food productivity: "Hāna was a fertile land where taro, sweet potatoes, bananas, sugar cane, and wild fruits grew in abundance, and there was always much food to be had. Kawaipapa was rich in fish from ponds and from the sea…." [21]

According to Hawaiian ethnobotanist and cultural historian E.S.C Handy, Kipahulu was a moku with rich and diverse but scattered agricultural resources. Its great valley and lower fringing forests nourished forest taro and other native food plants, as did the lower kula lands above the sea, where the native homes are today. Formerly sugar plantation, this land is now a cattle ranch.[22]

---

[19] County of Maui, Maui County General Plan 2030, Maui Island Plan, Chapter 8: Directed Growth Plan
[20] ibid

[21] Kamakau, Samuel M. *Ruling Chiefs of Hawai'i.* The Kamehameha Schools Press: Honolulu [2 vols.], 1961, page 24.
[22] Ibid, 156

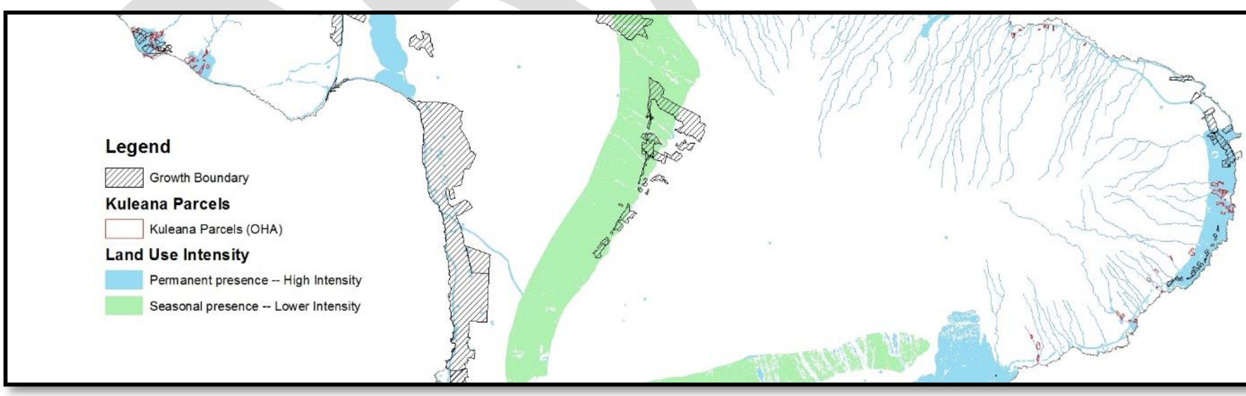
Taro Culture Dominance

Upslope at the mid-elevations in north Hāna, relatively recent lava flows (within the past 15,000 years) have created a rugged terrain lacking perennial streams and wet taro terraces. However, dry land taro is abundant due to the combination of humus and eroded lava frequently watered by rainfall, except during occasional droughts. Dry taro has been historically planted in Honokalani, a formerly large Native Hawaiian settlement; Helani, inland from Hāna Town; and in the forest above Hāna Town, at about 1,500 feet elevation in a small valley below Olopawa Peak, formerly cultivated in dry land kalo during the dry season.[23]

> *"South of Hamoa the land is less rugged and streams are more plentiful. The Hawaiian homesteads at Maka`alae, Waiohinu, Pu`uiki, Pohue, Pukuilua, Haou, Hulihāna, Muolea, and Koali have extensive plantations, but only a small proportion of the cultivation is devoted to dry taro. There is no evidence of wet taro cultivation in the Hāna district north of Koali. Here, however, both above and below the road, there are small groups of terraces, some of which are still used for wet taro. The taro terraces nearest Wailua are a picturesque example of high terracing with stone facing on a steep slope."* [24]

Today (2017), kalo is still grown in Wailua Valley and can also be seen in the vicinity of Wailua Falls along Honolewa Stream, as well as the area North of the falls looking toward the mauka side from Hāna Highway. One account from Handy cites the excessive wetness of Hāna as a reason for comparatively little sweet potato cultivation, except in certain areas.[25] The map below shows that the Hāna ASEA had sufficient resources to support a permanent presence, higher population intensity and extensive agricultural use.

Figure 17-7 Estimated Native Hawaiian Pre-Contact Land Utilization and Kuleana Lands Compared to Growth Boundaries



Source: The Nature Conservancy, Ladefoged, T.N. et al (2011), and Maui Island Plan (2012)

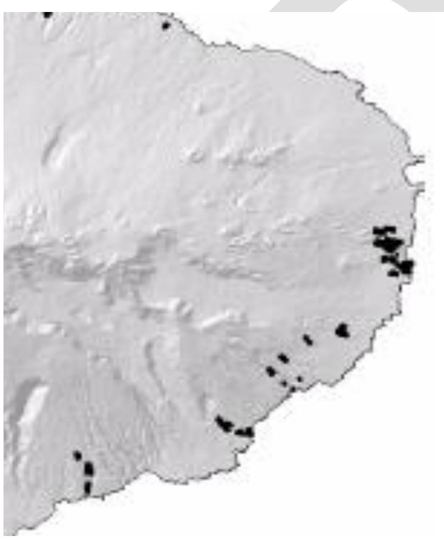
[23] Ibid. 111
[24] E.S.C. Handy, Hawaiian Planter, page 111 [Sterling, Elspeth P. *Sites of Maui.* Bishop Museum Press, 1997, page 120].
[25] Ibid.

Kuleana Parcels

Water rights include "appurtenant or kuleana water rights" to use that amount of water from a water source (usually a stream) which was used at the time of the Māhele of 1848 on kuleana and taro lands for the cultivation of taro and other traditional crops and for domestic uses on that land, and "riparian rights," which protect the interests of people who live on land along the banks of rivers or streams to the reasonable use of water from that stream or river on the riparian land subject to other rights of greater value.[26] These rights run with the land.[27] The many varied definitions for "kuleana" water users are included under section 10.2 (Ka Pa`akai Analysis).

Traditional and cultural Hawaiian practices are deeply intertwined with the geographical environment of the islands. Prior to the arrival of westerners and the idea of private land ownership, Hawaiians communally managed, accessed and gathered the resources from the land and seas to fulfill their community responsibilities. Traditional and customary native Hawaiian rights are exercised in the streams in the form of subsistence gathering of native fish, mollusks, and crustaceans, and stream flows are diverted for the cultivation of wetland taro, other agricultural uses, and domestic uses that can be traced back to the Mahele. The maintenance of fish and wildlife habitats to enable gathering of stream animals and increased flows to enable the exercise of appurtenant rights constitute the instream exercise of "traditional and customary" Hawaiian rights.[28]

Figure 17-8 Hāna ASEA Kuleana Lands



Source: Office of Hawaiian Affairs data

---

[26] Haia, Moses. *Protecting and Preserving Native Hawaiian Water Rights.* AluLikeWorkbook
[27] Ola I Ka Wai: A Legal Primer For Water Use And Management In Hawai'i

[28] CWRM East Maui Streams Hearing Officer's Recommended FOF, COL, and D&O, January 15, 2016. Contested Case No. CCH-MA 13-01 http://files.Hawai`i.gov/dlnr/cwrm/cch/cchma1301/CCHMA1301-20160115-HO-D&O.pdf

Water

Hāna is famous for its rains and extensive spring water. For example, the area in front of the Hāna Kai hotel is known for the many springs in the ocean that were used by the ancient people, and Hamoa Beach and Wai`ānapanapa State Park are world renown for their spring water-fed beaches: saltwater/ freshwater mixing zones that in ancient times were used for therapeutic healing.[29] Kauiki Hill is likewise known for an ample supply of spring water that historically supplied the hillside fortress. Other water legends tell of a certain Chief at Kauiki "…that thrust his spear into the heavens for Hāna's fame, as Hāna of the low heavenly rain."[30] "Hāna's famous rain is the 'Ua-kea.' When this rain falls…is after sunrise, at 9 or 10 in the morning ... Then the rain gives us some moisture. It does this to us every day."[31]

The extensive freshwater springs found throughout Hāna demonstrate the upslope precipitation capacity of the mountain.

Hawaiian Culture Today

The sensitivities of the region's residents for the cultural resources which are located within the Hāna district should be recognized. The historic sites and cultural resources provide evidence of Hāna's history and serve as tools for conveying the heritage of the region to its youth as a legacy for the future.[32] Today, numerous events such as the East Maui Taro Festival, Hāna Festivals of Aloha, the Hāna Limu Festival, and community groups such as hula halau and outrigger canoe clubs, help perpetuate the traditional Native Hawaiian culture in Hāna. A few of the cultural organizations and institutions are discussed below.

<u>Hāna Cultural Center</u>

The Hāna Cultural Center features traditional artifacts that were used by the ancient Hawaiian people in their everyday life, worship, fishing, and other aspects of their lives, including the life stories of those who made an impact on Maui and especially Hāna. Established by kupuna (wise elders) to perpetuate the traditional way of life of Hāna and to honor the Hawaiian Cultural Renaissance, the museum houses ancient artifacts including Hawaiian quilt, poi boards, stone implements, Polynesian kapa, fish nets and hooks. Listed on the National Register of the Historic Places, the old Hāna Courthouse is still used today on the grounds alongside Kauhale Village, a replica of a pre-contact chief's compound. Various cultural presentations and events are held regularly and are open to the public.

---

[29] Sterling, Elspeth P. *Sites of Maui.* Bishop Museum Press, 1997, page 127.

[30] Thomas G. Thrum. More Hawaiian Folk Tales, Hawaiian Annual for 1923, pages 68-69 [Sterling, Elspeth P. *Sites of Maui.* Bishop Museum Press, 1997 page 131].

[31]D.S. Kaho'okano, *Hāna and the Country Life There*, La Nupepa Kuakoa, February 27, 1869 Hawaiian ethnological Notes, 1:2978 [Sterling, Elspeth P. *Sites of Maui.* Bishop Museum Press, 1997 page 131].

[32] County of Maui, Hāna Community Plan, 1994, pages 10-11.

Kahanu Garden

Kahanu Garden and Preserve is a botanical garden located in Hāna. It is one of five gardens of the non-profit National Tropical Botanical Garden. The garden's ethnobotanical collections focus on plants traditionally used by Pacific Island people. It includes the world's largest breadfruit collection, first established in the 1970s. Today the garden contains accessions of approximately 150 varieties of breadfruit collected from field expeditions to over 17 Pacific island groups in Polynesia, Micronesia, and Melanesia, as well as Indonesia, the Philippines, and the Seychelles. This collection is used for research and conservation by NTBG's Breadfruit Institute. Kahanu Garden also contains the 3-acre Pi`ilanihale Heiau, a National Historic Landmark believed to be the largest ancient temple in the Hawaiian Islands.[33] Construction of the main terrace dates back to the 14th century. Wings were later added and rededicated during the 16th century, possibly after high chief Pi`ilani from western Maui conquered the beautiful, fertile, well-watered, and heavily populated Hāna region, thereby unifying the whole island.[34]

Kipahulu `Ohāna

Long before the first Europeans arrived on Maui, Kipahulu was prized by the Hawaiian royalty for its fertile land and ocean. Thousands of people once lived a sustainable lifestyle in this area farming, fishing, and surviving with the resources of the `ahupua`a. In 1995, a small group of Native Hawaiian residents came together to revive, restore, and share the practices of traditional Native Hawaiian culture with others in Kipahulu. The Kipahulu `Ohāna is a nonprofit organization dedicated to educating residents and visitors of the "ways of old," through cultural demonstrations and hands-on activities. Using the wisdom and spiritual guidance of their elders, learned teachers, they seek to re-establish a Hawaiian lifestyle in Kipahulu. By initiating sustainable projects, dividing the labor, and sharing the results, they seek to preserve their Native Hawaiian cultural practices. They operate Kapahu Living Farm, a traditional Hawaiian wetland taro farm located in Haleakalā National Park and managed through a partnership agreement with the park service, where they host educational programs for schools and community groups and distribute poi and other products to the local community. They also manage a state leased parcel with fruit orchard and cattle pasture and conduct feral animal control fencing and invasive plant removal in the Kipahulu forest.[35] Like their ancestors, they are caring for the land so that its abundance may be shared by future generations in perpetuity.

Kukulu Kumu Hāna

Kukulu Kumu Hāna is a student-based agricultural business on five acres located within the DHHL Wakiu Tract. The five acres along Hāna Highway that is licensed to Kukulu Kumu Hāna for community and cultural uses has been cleared and a cultural center has been erected where

[33] Pi`ilanihale Heiau". National Historic Landmark summary listing. National Park Service. Retrieved 2008-07-04

[34] Kirch, Patrick Vinton (1996). "Piʻilanihale Heiau". Legacy of the Landscape: An Illustrated Guide to Hawaiian Archaeological Sites. Honolulu: University of Hawai`i Press. pp. 72–74. ISBN 0-8248-1739-7.

[35] Kipahulu Ohana Website (http://kipahulu.org/)

they provide Hāna High and Intermediate School students with vocational agricultural based skills and cultural education.[36]

Lessons Learned from the Past

The Hāna region encompasses a vast and diverse rural area. In the past, the area supported many Hawaiian villages and a much larger Native Hawaiian population, but disease, gentrification, and major changes in the cultural and socio-economic landscape has drastically reduced the population and those that live by those cultural traditions. Although Hāna is still considered by many to be one of the most traditional "Hawaiian" places in Hawai`i; contemporary Hāna is undergoing changes that are resulting in social, economic and cultural upheaval, including a revival of ancient Native Hawaiian traditions and practices. Protecting the vast array of cultural resources in the Hāna District is important to not only the people of Hāna, but to the entire Island of Maui and the Hawaiian people. The district's historic sites provide evidence of Hāna's history and serve as tools for conveying the heritage of the region to its youth as a legacy for the future. Great care must be given to ensure that future development is done in a culturally sensitive manner.[37]

History paints a much different picture of Hāna's past carrying capacity when compared to today. Pre-contact populations in Hāna are thought to have significantly exceeded today's population, sustained by rain fed agriculture and ocean resources.[38] Until relatively recently (mid-1900s), population and agricultural potential for the area was excellent, but re-population of this remote area is not forecast in the County's Maui Island Plan or expected to be supported by economic opportunity or infrastructure. Abundant water resources could theoretically support an increase in Native Hawaiian domestic and agricultural uses. During community meetings in connection with formulation of the WUDP, Native Hawaiians and others in the Hāna area expressed concern with the westward transport of "Hāna" water, and this sentiment underscores the community's perceived connectivity of water resources to their "sense of place." As previously mentioned, diversions through the EMI system to Central Maui are within the Ko`olau ASEA, including Makapipi Stream in Nahiku. Therefore, from a technical standpoint, Hāna water is *not* transported outside of the Hāna ASEA, and may continue to be available for utilization by Native Hawaiian cultural practitioners. While a return to the larger population of the past may not appear imminent, evidence exists of a cultural resurgence taking place that may play a greater role in transforming Hāna today and into the future.

[36] State of Hawai`i, Department of Hawaiian Home Lands, Maui Island Plan, 2004
[37] County of Maui, Maui County General Plan 2030, Maui Island Plan, Chapter 8: Directed Growth Plan

[38] The Nature Conservancy, Office of Hawaiian Affairs, Ladefoged, T.N., et al (2011), and Maui island Plan

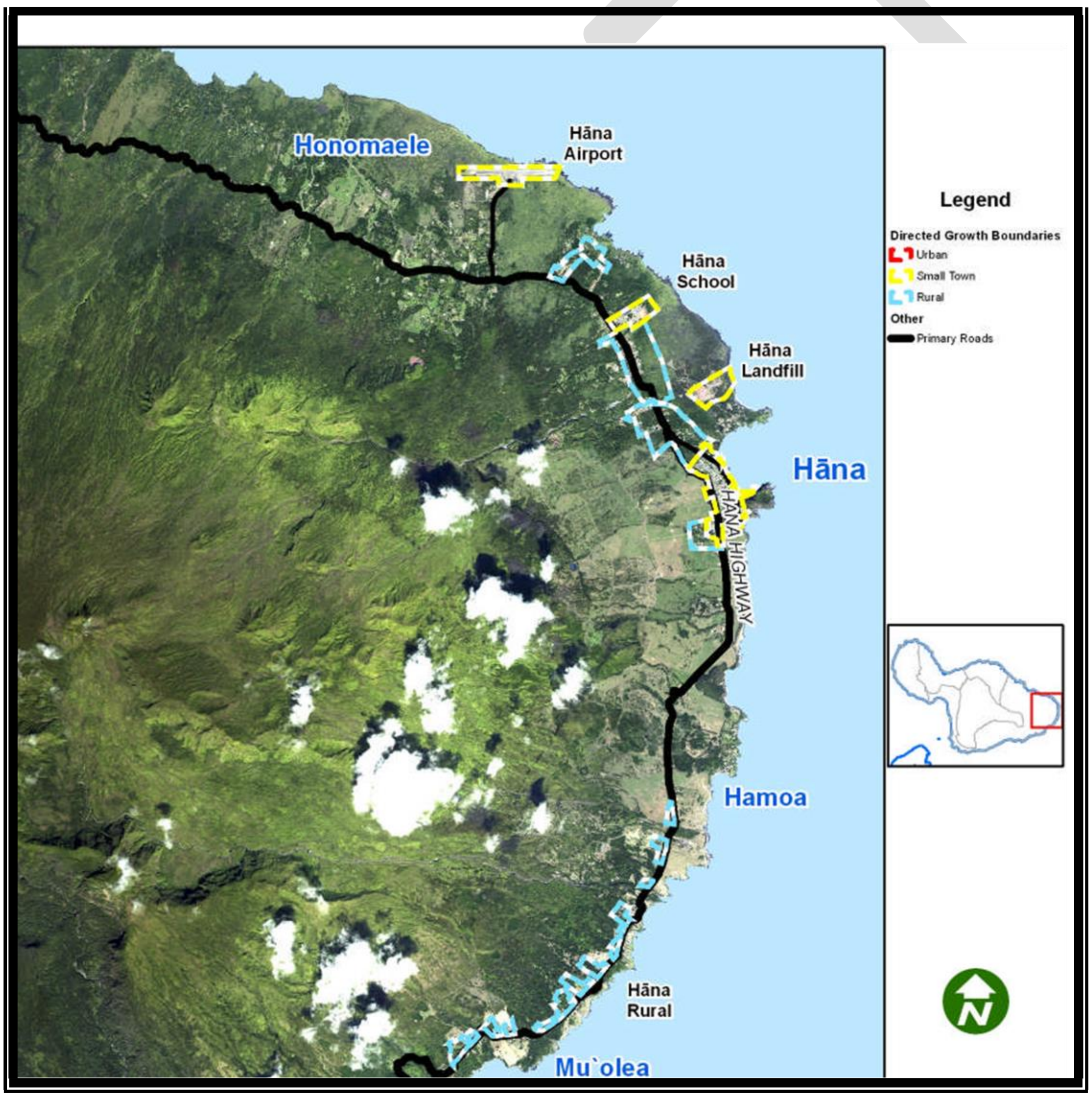
18.4 Land Use

The current land use pattern in the Hāna Aquifer Sector Area (ASEA) is dominated by rural and sparsely populated communities along the coast, with limited development and undeveloped areas mauka.

18.4.1 Land Use Plans

Maui Island Plan directed growth boundaries in the Hāna ASEA are classified as either Small Town or Rural as indicated in the map below.

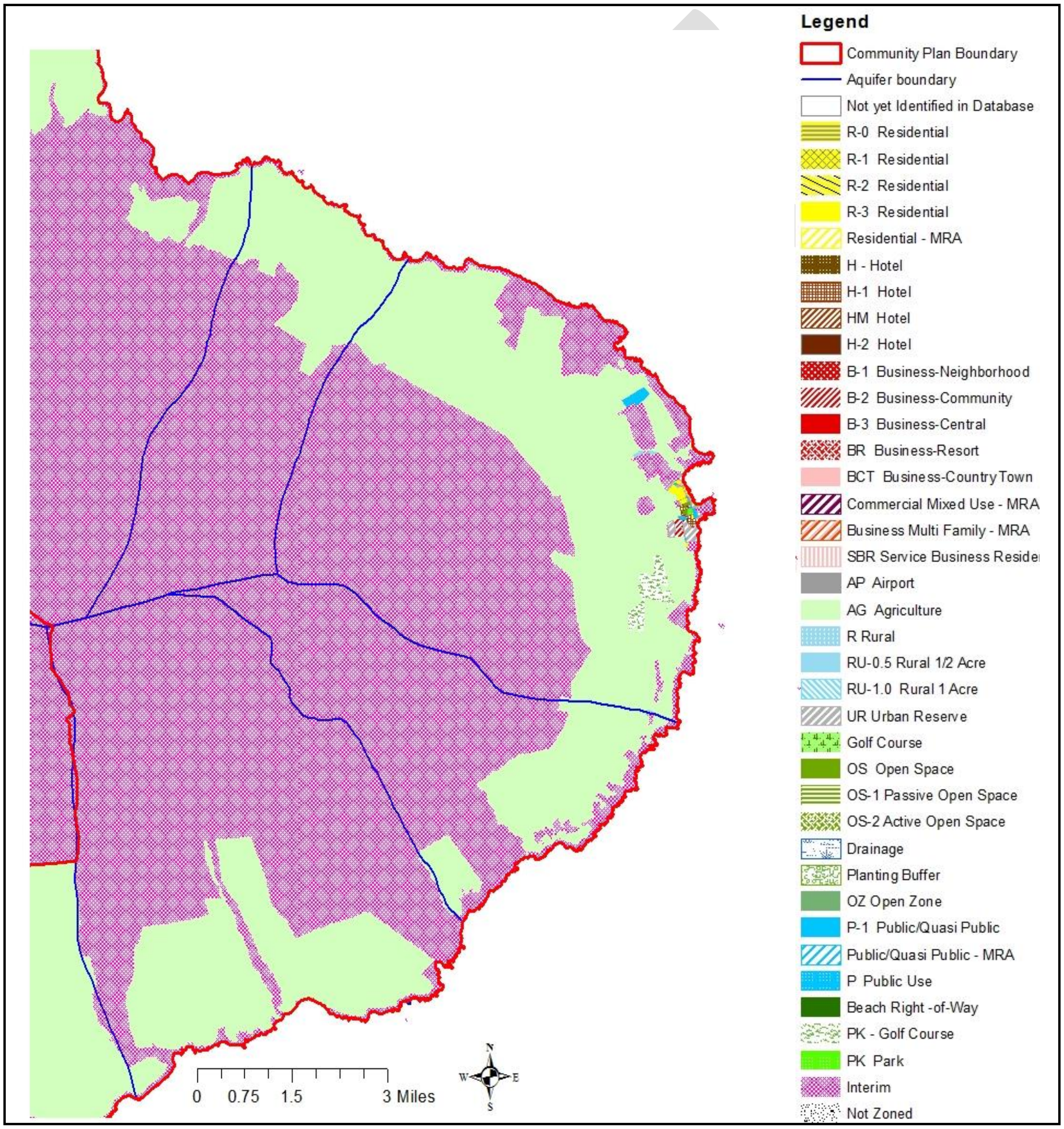
Figure 17-9 Directed Growth Plan: Hāna Planned Rural Growth Area



Source: County of Maui, Directed Grown Plan, Hāna – Planned Rural Growth Area.

The Hāna Community Plan includes approximately half of the Ko`olau ASEA and most of Kahikinui ASEA. It additionally encompasses all or portions of various moku (Ko`olau, Hāna, Kīpahulu, Kaupō, Kahikinui, Hāmākualoa) and their underlying ahupua`a. Outside of the rural coastal areas, most of the land is designated Agricultural and Conservation. The corresponding County Zoning Designation is dominated by Ag and Interim Zoning.

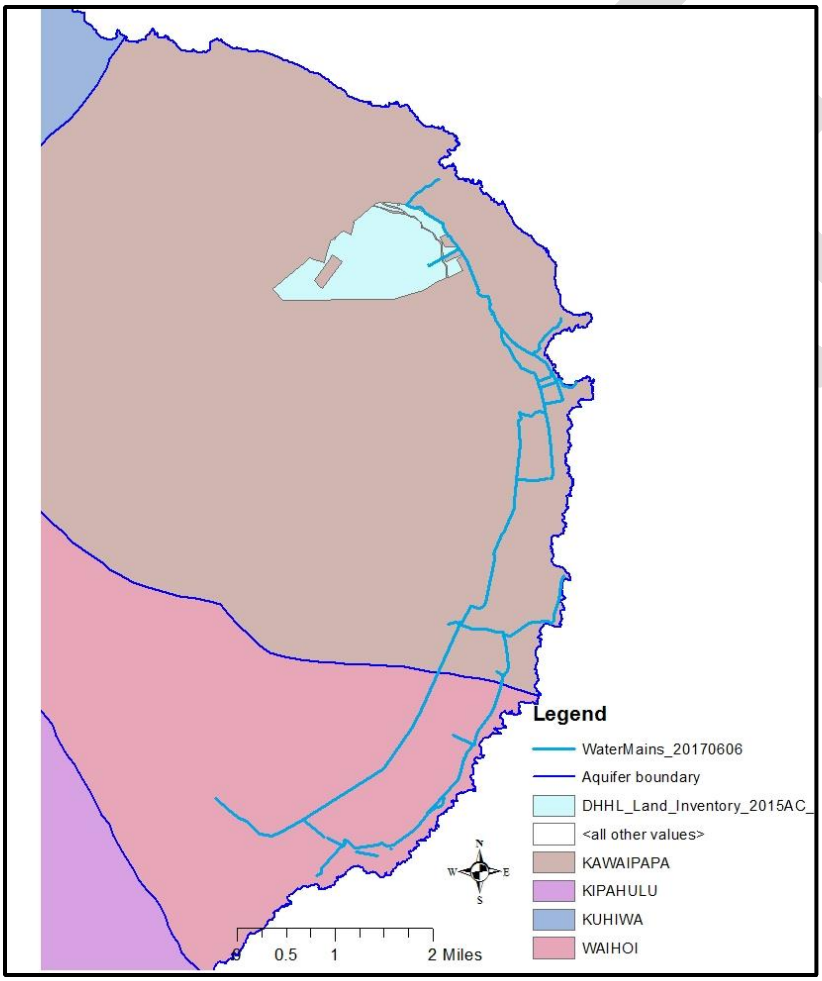
Figure 17-10 Hāna ASEA Community Plan Boundaries and County Zoning Districts



19.4.1 The DHHL Maui Island Plan

The Hawaiian Homes Commission adopted its Maui Island Plan as the overarching planning document in 2004. The Department of Hawaiian Homelands (DHHL) East Maui planning region encompasses three tracts totaling 985 acres: Keanae, Wakiu, and Wailua. All three tracts are within the Hāna Community Plan; however, only Wakiu is within the Hāna ASEA, it covers 743 acres, and the tract is zoned Agricultural.[39] The proposed land use for Wakiu includes 46 acres of one-half acre residential lots, 75 acres of three-acre subsistence agricultural lots, five acres of community use, five acres of commercial use, five acres of industrial use, and the balance of the tract (522 acres) in general agriculture.

Figure 17-11 Hāna ASEA Department of Hawaiian Homelands



[39] State of Hawai`i, DHHL Maui Island Plan, 2004.

As discussed by the Water Development Analysis for the Department of Hawaiian Home Lands Tracts on the Island of Maui, there is a Maui Department of Water Supply (MDWS) 0.5 million gallon concrete storage tank on the Hāna side of the Wakiu tract at an elevation of 310 feet. The storage tank is fed by two wells, and a 12-inch water line extends from the tank to Hāna Highway and along Hāna Highway towards Hāna Town. A 6-inch water line runs north along Hāna Highway to Wai`ānapanapa Road. The existing 0.5 MG water tank can service the area along Hāna Highway from an elevation of approximately 140 feet above Mean Sea Level (msl) to 200 feet above msl. Improvements to the water system are needed to service the remaining areas of the tract. The DHHL is asking the MDWS to connect portions of the Wakiu and Hamoa systems and construct a back-up well to supplement the Hāna system.[40] DHHL is also considering partnering with MDWS in developing a well for the tract.

[40] State of Hawai`i, DHHL Maui Island Plan, 2004, Page 6-1

17.5 EXISTING WATER USE

17.5.1 Water Use by Type

The CWRM has established the following water use categories based for the purposes of water use permitting and reporting:

- Domestic (Residential Domestic; Single and Multi-Family households, including noncommercial gardening; Non-residential Domestic; Commercial Businesses; Office Buildings, Hotels, Schools, and Religious Facilities)
- Industrial (Fire Protection, Mining, Dust Control, Thermoelectric Cooling, Geothermal, Power Development, Hydroelectric Power, and Other Industrial Applications)
- Irrigation (Golf Course, Hotels, Landscape and Water Features, Parks, School, and Habitat maintenance)
- Agriculture (Aquatic Plants & Animals, Crops Irrigation and Processing, Livestock Water, Pasture Irrigation, and Processing, Ornamental and Nursery Plants, Taro, Other Agricultural Applications)
- Military (all military use)
- Municipal (County, State, Private Public Water Systems as defined by Department of Health)

This section presents the estimated water use within the Hāna ASEA for the calendar year 2014, or as otherwise stated based CWRM and MDWS reports. County of Maui Municipal well use dominates total well production for the Hāna ASEA at 73%. The Hāna ASEA includes 31 wells, of which 28 are considered "production" wells, the remainder are classified as "unused" and do not produce water.

Table 17-5 Reported Pumpage and Surface Water Use by Type, Hāna ASEA, 2014 (gpd)

Aquifer	Domestic	Industrial	Agriculture	Irrigation	Municipal	Military	Total
Total No. of Production Wells	14	0	3	5	7	0	29
Kūhiwa	0	0	0	1,315	0	0	1,315
Kawaipapa	0	0	0	0	600,487	0	600,487
Waiho`i	0	0	0	0	0	0	0
Kipahulu	3,976	0	0	0	0	0	3,976
Total Pumpage	**3,976**	**0**	**0**	**1,315**	**600,487**	**0**	**605,778**
% of Pumpage	0.65%	0%	0%	0.22%	99.13%	0%	100%
Total No. of Surface Water Diversions	69	0	0	0	1	0	70
Kūhiwa	1,408	0	0	0	0	0	1,408
Kawaipapa	2,047	0	0	0	0	0	2,047
Waiho`i	49,562	0	0	0	0	0	49.562
Kipahulu	93,674	0	0	0	0	0	93,674
Total Amount Diverted	**146,691**	**0**	**0**	**0**	**0**	**0**	**146,691**
Percent of Surface Water	100%	0	0	0	0%	0	100%
TOTAL	**150,667**	**0**	**0**	**1,315**	**600,487**	**0**	**752,469**

Source: CWRM Well Pump Quantities Database, 2014; 12-month moving average, January to December 2014; where data was not reported consecutive months in 2015 were used. Some wells did not report.
CWRM Gages 2011-2015 Average, estimated end use; Municipal use based on MDWS production. 1989 Declarations of Water Use, Circular 123, Volumes 1 and 2, CWRM, September 1992.

Figure 17-12 Pumpage by Well Type, Hāna ASEA, 2014

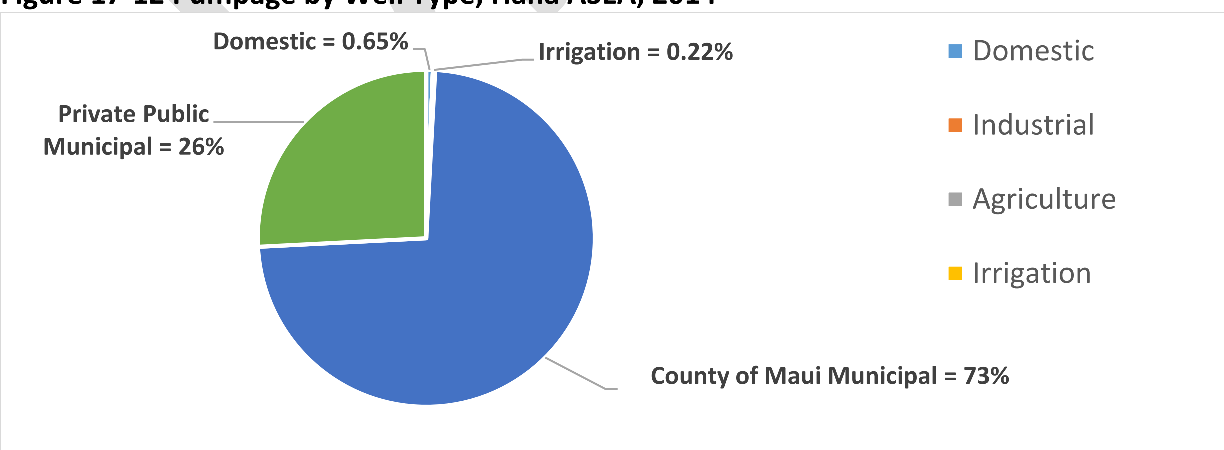
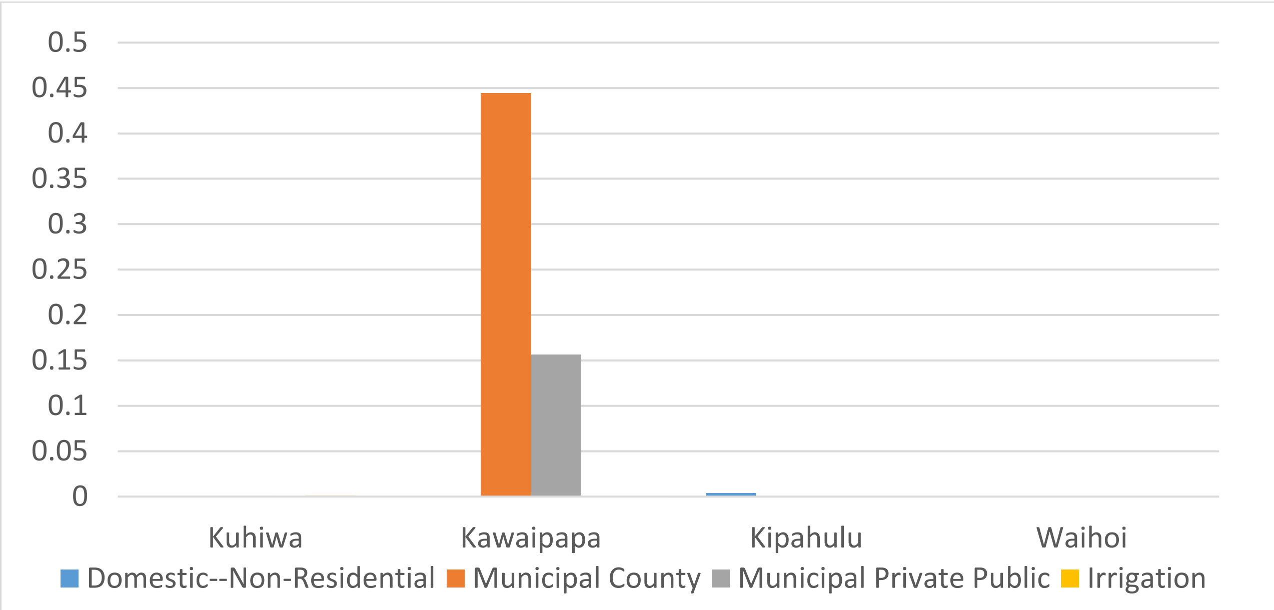


Figure 17-13 Pumpage by Well Type, Hāna ASYAs, 2014 (mgd)



Source: CWRM Well Pump Quantities Database, 2016; 12-month moving average, January to December 2014; where data was not reported consecutive months in 2015 were used. Some wells did not report.

Domestic Use

There are 14 Domestic wells in the Hāna ASEA, all located in Kipahulu, with a combined reported pumpage of 3,976 gpd, or less than 1% of the Hāna ASEA total pumpage. It is likely that domestic use is underreported.

Industrial Use and Military Use

There is no reported pumpage from industrial wells in the Hāna ASEA. There are no military wells.

Irrigation Use

Irrigation wells comprised less than 1 percent of total Hāna ASEA average well pumpage in 2014, averaging 1,315 gpd. In theory, irrigation use by private purveyors can be estimated from reported streamflow diversions and reported or appraised agricultural irrigation. However, this data is unreported for the Hāna ASEA.

Agricultural Use

CWRM pumpage reports indicate there was essentially no water pumped by agricultural production wells in 2014 in the Hāna ASEA. However, the agricultural well pump capacity for the area is 3.717 mgd. Agricultural uses are primarily supplied by surface water and occasionally augmented with groundwater.

Table 17-6 Estimated Agricultural Water Use, Hāna ASEA (Excluding Kuleana Parcels)

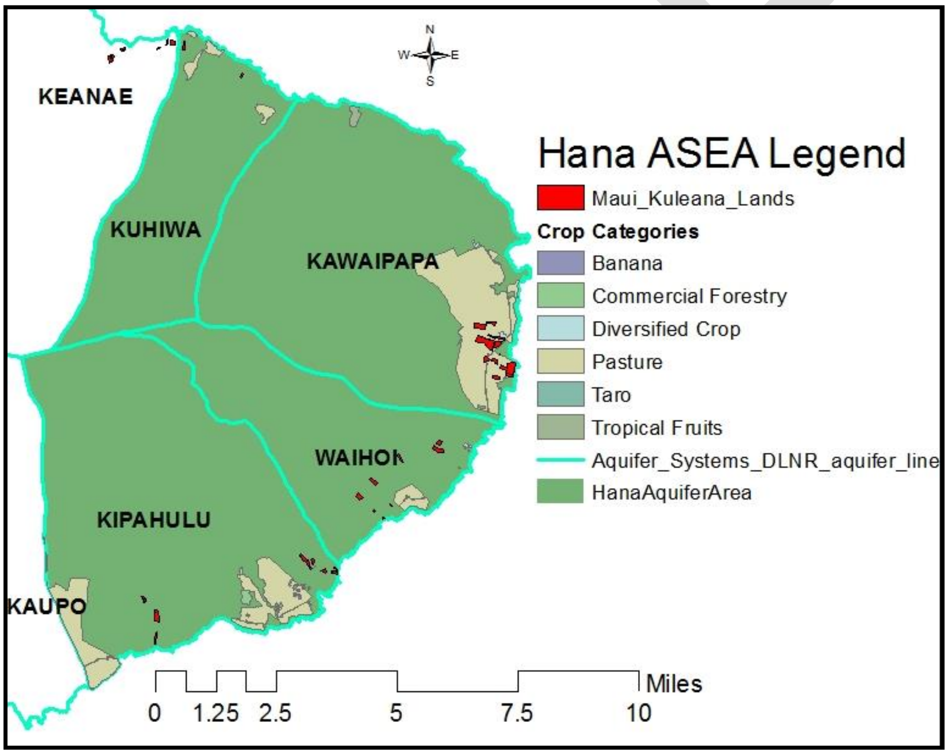
Aquifer System	2015 Ag Baseline Crop Category	Estimated Acreage	Water Standard (gpd)	Estimated Average Water Use (gpd)
Kipahulu	Taro	2.56	27,500 (15-40K)	70,400
Kipahulu	Diversified Crop	2.01	3,400	6,834
Kipahulu	Commercial Forestry	33.12	4,380	145,065.60
Kipahulu	Banana	22.28	3,400	75,752
Kipahulu	Pasture	1,463.33	0* (0-7,400)	0*
Kipahulu Sub-Total		**1,523.30**		**298,051.60**
Waiho`i	Taro	0.51	27,500 (15-40K)	14,025
Waiho`i	Diversified Crop	5.44	3,400	18,496
Waiho`i	Banana	0.36	3,400	1,224.00
Waiho`i	Pasture	157.21	0* (0-7,400)	0*
Waiho`i Sub-Total		**163.52**		**33,745**
Kawaipapa	Diversified Crop	30.33	3,400	103,122
Kawaipapa	Tropical Fruits	47.93	10,000	479,300
Kawaipapa	Pasture	2,377.50	0* (0-7,400)	0*
Kawaipapa Sub-Total		**2,455.76**		**582,422**
Kuhiwa Sub-Total	Pasture	**159.96**	0* (0-7,400)	**0***
Total		**4,142.58**		**914,218.60**

Source: 2015 Statewide Agricultural Baseline GIS, acreages calculated by MDWS. Kuleana parcels included in the 2015 Statewide Agricultural Baseline are not included in this analysis, as they are accounted for in a subsequent analysis within this report.
It is not specified whether taro is dryland or wetland.
Estimated Water Use for taro: average wetland taro consumptive rate. Coffee: 2004 AWUDP Kaua`i Irrigation System- 2500 gpd; 2900 gpd reported by plantation on Oahu per Brian Kau, HDOA, personal communication, 10/12/2016.
*Most pasture is not irrigated and uses no water.

The characterization and adequacy of streamflow for lo`i kalo and other instream uses is a community concern. Information about existing and potential lo`i kalo and other agricultural uses on Kuleana parcels in the Hāna ASEA is not readily available, and despite consultation with the Aha Moku Council and others, quantitative information was not forthcoming through the WUDP process. Other Information from the CWRM reports, 2015 Statewide Agricultural Land Use Baseline, CWRM 1989 Declarations of Water Use, and other sources were consulted.

Information in the 1989 Declarations of Water Use, Volumes 1 and 2 (CWRM, September 1992), was used to characterize water sources. This information was then correlated with CWRM diversions, Kuleana parcels, and the 2015 Statewide Agricultural Land Use Baseline. The declarations include water sources and uses made known to the CWRM through a registration process in 1988-1989, and does not include subsequent sources and uses developed and known to the CWRM through its permitting process and water use reporting.[41] The declarations also included claims for future water rights, the proposed future uses of water, and current instream activities. The declarations as well as the summary below have not been verified by the CWRM. While there are many limitations inherent in the declarations (parcels with multiple declarations with conflicting information, some parcels may indicate place of diversion rather than water application, parcel ownership may differ from declarant, etc.), they provides a point of reference to support in a more complete characterization of existing and potential future use.

Figure 17-14 Relationship of Kuleana Parcels and 2015 Statewide Agricultual Land Use Baseline



Source: HDOA 2015 Statewide Agricultural Land Use Baseline, Kuleana parcels (OHA 2009)

[41] The 1987 State Water Code, HRS Chapter 174C, required any person making a use of water in any area of the state to file a declaration of that water use, any person owning or operating any well must register the well, and any person owning or operating any stream diversions works must register the diversion.

A significant number of Kuleana parcels exhibit a declaration of use for either an existing or future use. Estimated demand for land uses in the Declarations of Water Use is 0.248 mgd based on the stated assumptions. Given that much of the 2015 Statewide Agricultural Land Use Baseline inventory does not intersect with the declarations, the declarations appear to represent an additional increment of agricultural water use.

An analysis of Kuleana parcels and the 2015 Statewide Agricultural Land Use Baseline indicates that taro and diversified crops cultivated on Kuleana parcels in the Hāna ASEA totaled about 18.53 acres as shown in the tables below. However, given the purpose of the 2015 Agricultural Land Use Baseline inventory to capture the scale and diversity of commercial agricultural activity, it is likely that most agriculture on Kuleana parcels was not mapped. In the table below, taro is assumed to be wetland taro. The midpoint of the range for consumptive water use for wetland taro is used to calculate estimated average water use. The low and high figures for consumptive water use and streamflow required for healthy plants are also provided.

Table 17-7 Estimated Water Use by Kuleana Parcels *also* located within 2015 Agricultural Land Use Baseline, Hāna ASEA (gpd/acre)

Aquifer System	2015 Crop Category	Kuleana Parcels Acreage	Water Standard	Est. Ave. Water Use	Consumptive Use		Streamflow	
					Low 15,000	**High** 40,000	**Low** 100,000	**High** 300,000
Kawaipapa	Pasture*	104.51	0* (0-7,400)	**0**	--	--	--	--
Kawaipapa	Diversified	8.30	3,400	**28,220**	--	--	--	--
Waiho`i	Taro	0.13	27,500	**3,575**	1,950	5,200	13,000	39,000
Total		**112.94**		**31,795**				

Sources: 2015 Statewide Agricultural Land Use Baseline GIS; Kuleana parcels-OHA, 2009. Approx. agricultural acreages overlying Kuleana parcels calculated by MDWS using GIS intersection of Kuleana parcels (OHA 2009) and 2015 Agricultural Land Use Baseline data.
Water Use Rates: Diversified Ag-HDOA Guidelines; Taro-CWRM Na Wai `Eha and East Maui Streams Contested Case Hearings. Due to proximity of parcels to stream, taro is assumed to be wetland taro. Water standard for taro is average consumptive range of 15,000 to 40,000 gpa.
*Most pasture is not irrigated and uses no water

Table 17-8 Estimated Water Use by Kuleana Parcels *not* located in 2015 Agricultural Land Use Baseline, Hāna ASEA (gpd/acre)

Aquifer System	2015 Crop Category	Kuleana Parcels Acreage	Water Standard	Est. Ave. Water Use	Consumptive Use		Streamflow	
					Low 15,000	**High** 40,000	**Low** 100,000	**High** 300,000
Kawaipapa	Pasture*	7.95	0* (0-7,400)	0*	--	--	--	--
Kawaipapa	Diversified**	0.63	3,400	2,146**	--	--	--	--
Kawaipapa	Taro***	0.01	27,500	272***	148	396	989	2,966
Kawaipapa Total		**8.59**		**2,418**	**148**	**396**	**989**	**2,966**
Kipahulu	Pasture*	53.46	0* (0-7,400)	0*	--	--	--	--
Kipahulu	Diversified**	4.24	3,400	14,435**	--	--	--	--
Kipahulu	Taro***	0.07	27,500	1,829***	997	2,660	6,650	19,949
Kipahulu Total		**57.77**		**16,264**	**997**	**2,660**	**6,650**	**19,949**
Kuhiwa	Pasture*	6.51	0* (0-7,400)	0*	--	--	--	--
Kuhiwa	Diversified**	0.52	3,400	1,757**	--	--	--	--
Kuhiwa	Taro***	0.008	27,500	223***	121	324	809	2,428
Kuhiwa Total		**7.038**		**1,979**	**121**	**324**	**809**	**2,428**
Waiho`i	Pasture*	30.85	0* (0-7,400)	0*	--	--	--	--
Waiho`i	Diversified**	2.45	3,400	8,331	--	--	--	--
Waiho`i	Taro***	0.04	27,500	1,055	576	1,535	3,838	11,513
Waiho`i Total		**33.34**		**9,386**	**576**	**1,535**	**3,838**	**11,513**
Total		**106.738**		**30,047**				

Source: Kuleana parcels-OHA, 2009. Approx. agricultural acreages overlying Kuleana parcels calculated by MDWS using GIS intersection of Kuleana (OHA 2009) and 2015 Agricultural baseline data.
Water Use Rates: Diversified Ag-HDOA Guidelines; Taro-CWRM Na Wai `Eha and East Maui Streams CCH. Due to proximity of parcels to stream, taro is assumed to be wetland taro. Water standard for taro is average consumptive range of 15,000 to 40,000 gpa.
*Most pasture is not irrigated and uses no water
**Div Ag not included in 2015 Ag Baseline data estimated to be 7.35% of total acreage based on the ratio of Div to total acreage in the GIS intersection of Kuleana (OHA 2009) and 2015 Agricultural Baseline data.
***Taro crop cultivation not included in 2015 Ag Baseline data was estimated to be 0.12% of total acreage based on the ratio of Taro to total acreage in the GIS intersection of Kuleana parcels (OHA 2009) and 2015 Ag Baseline data.

Table 17-9 1989 Declarations of Water Use and Surface Water Diversions, Hāna ASEA

Stream Source	1989 Dec. of Water Use (mgd)	No. of Diversions
Kuhiwa	0	0
Waihole	0.001	2
Manawaikeae	0	0
Kahawaihapapa	0	0
Keaaiki	0	2
Waioni	0	2
Lanikele	0	1
Heleleikeoha	0.001	14
Kawakoe	0.002	15
Honomaele	0	4
Kawaipapa	0	0
Mo`omo`onui	0	0
Haneo`o	0	0
Kapia	0.002	3
Waiohonu	0	0
Papahawahawa	0	0
Ala`alaula	0.007	2
Wailua	0.101**	4
Honolewa	0	1
Waieli	0	0
Kakiweka	0	1
Hahalawe	0	1
Pua`alu`u	0.112	4
Oheo	0	0
Kalena	0	1
Koukouai	0	2
Opelu	0	2
Kukuiula	0	1
Kaapahu	0	0
Lelekea	0	0
Alelele	0	0
Kalepa	0.018	2
Nuanua`aloa	0	3
Manawainui	0.004*	3
Total	**0.143**	**70**

Source: 1989 Declarations of Water Use, Circular 123, Volumes 1 and 2, CWRM, September 1992.
*The water use declaration from the Manawainui stream is used to provide non-potable surface water to the Kaupo community within the Kahikinui ASEA. Therefore, it is not counted as water use for the Hāna ASEA analysis.
**Previously declared diversion from MDWS. No longer in use. Not included in total.

The above table shows that only 143,000 gpd of water use are currently declared under the 1989 Declarations of Water Use. Many of the diversions have no associated water use quantities declared and several streams have neither diversions nor water use quantities declared. However, many of these areas likely have undeclared diversions in active use and therefore 143,000 gpd is probably an underestimate of water use.

In all, the estimated agricultural water use in the Hāna ASEA is approximately 1,119,060 gpd.

Table 17-10 Summary of Agricultural Water Use Analysis, Hāna ASEA

Agricultural Land Areas in Ag Water use Analysis	Estimated Water Use (gpd)
2015 Ag Baseline minus Kuleana Parcels	914,218
Kuleana Included in 2015 Ag Baseline Analysis (Subtracted from the Ag Baseline Total)	31,795
Kuleana not Included in 2015 Ag Baseline	30,047
1989 Declarations of Water Use*	143,000
Total Estimated Agricultural Water Use	**1,119,060**

*Previously declared diversion from MDWS of 101,000 in Waiho`i no longer in use and not included in total.

<u>Municipal Use</u>

Municipal use comprised about 99 percent of reported well pumpage in the Hāna ASEA, with single-family use dominating. MDWS wells accounted for approximately 73 percent of water withdrawn.

There are four municipal water systems using ground water within the Hāna ASEA. The County Department of Water Supply (MDWS), The National Park Service, and privately owned "public water systems" (PWS) as defined by the Department of Health (systems serving more than 25 people or 15 service connections) are summarized below.

The MDWS Hāna Water System serves most of the resident population with potable water, including the coastal areas of Hamoa, Hāna Town, and Nahiku. There are no interconnection between the Hāna Town/Hamoa system and the Nahiku system. The map below shows the general service areas of the public water systems in the region. The charts below show the proportion of water consumption by water provider, water use by type for the County's municipal system, and the source of this supply.

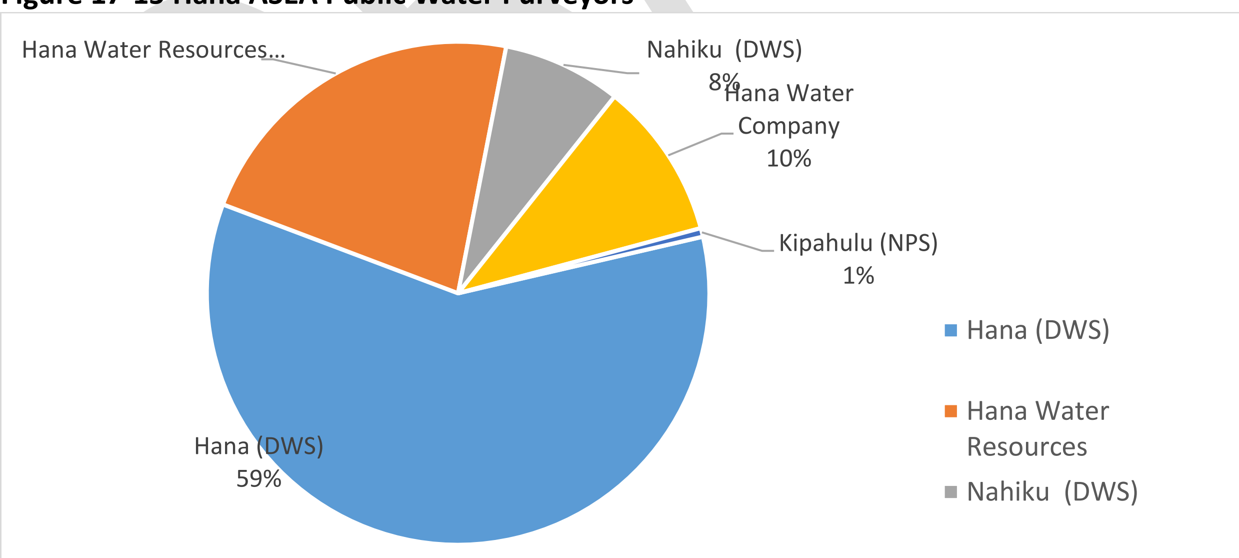
All potable systems in Hāna use groundwater. MDWS systems, The National Park Service public system, and other privately owned PWSs service connections and average water production are shown in the table below.

Table 17-11 Public Water Systems by Provider, Hāna ASEA

DOH No.	System Name	Operator	Population Served	Service Connections	Average Daily Flow (gpd)	Source
217	Hāna	MDWS	1,101	367	319,000	Ground
201	Hāna Water Resources	Hāna Water Resources	816	88	120,000	Ground
220	Nahiku	MDWS	107	43	41,000	Ground
243	Hāna Water Company	Hāna Water Company	160	99	54,426	Ground
260	Kipahulu	National Park Service	2,000	4	3,000	Ground
	Total				**537,426**	

Source: Department of Health, Safe Drinking Water Branch 2015 based on 2013 survey of water production submitted by providers every three years. All systems are "community" systems, except for DOH No.260 which is a "Transient Non-Community" system.

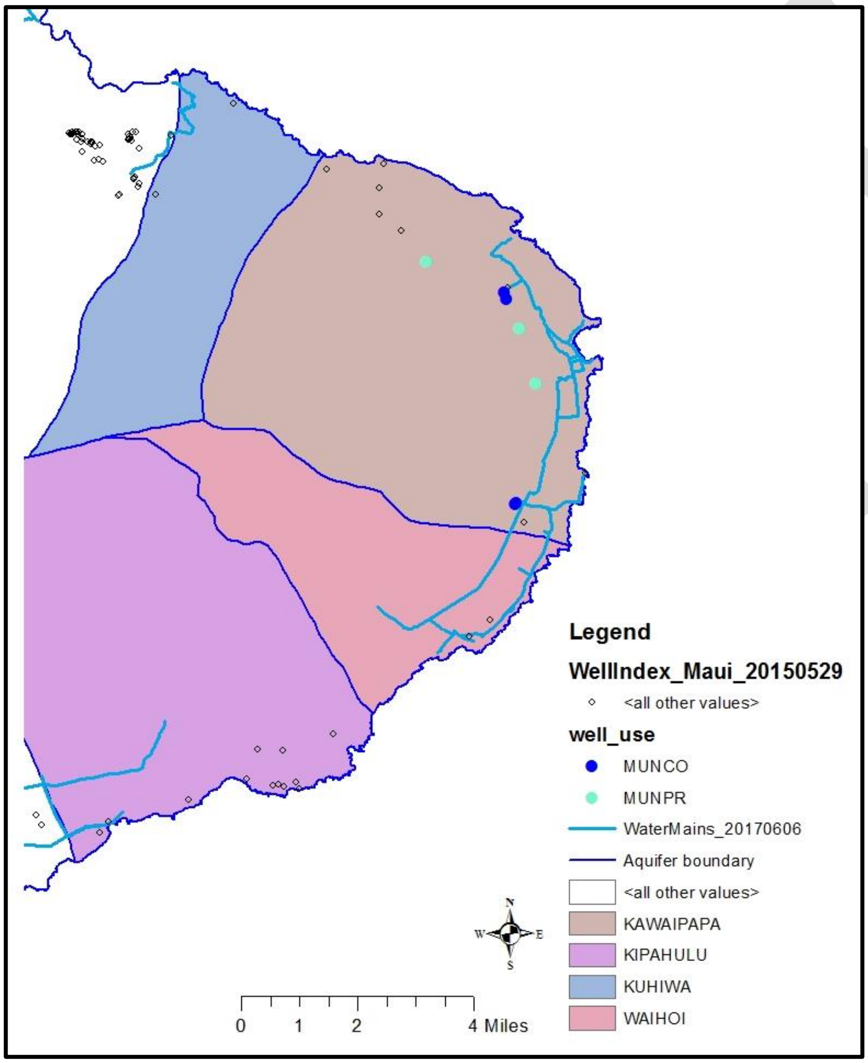
Figure 17-15 Hāna ASEA Public Water Purveyors



Source: Department of Health, 2015, data is updated every three years.

General locations of the county water mains and wells are shown below. The Hāna Ranch PWS and the MDWS service area overlap but are not connected. The Nahiku service area extends into Ko`olau ASEA. Portions of Kaupo hybrid system extends into Kipahulu (addressed in the Kahikinui Aquifer Sector report). The National Park Service well is not classified as "municipal" in the CWRM database but regulated as a public water system based on the number of visitors served.

Figure 17-16 Hāna ASEA General Location of Public Water Systems



MDWS Water System

The MDWS Hāna system generally serves the areas of Wakiu and Hamoa. Single-family residential use accounts for the greatest demand. Although the CWRM water use category

"Municipal" includes all MDWS billing classes, the table below provides a breakdown of water consumption that closest corresponds to CWRM sub-categories and actual water use.

Table 17-12 MDWS Service by CWRM Category (Includes Kawaipapa 911 and Kuhiwa/Nahiku 913 Subdistricts)

CWRM Categories	GPD	% of Total
Domestic	101,152	76.1%
Industrial	0	0.0%
Municipal	30,364	22.8%
Agriculture	30	0.0%
Irrigated	0	0.0%
Military	0	0.0%
Unknown	1,389	1.0%
Total	**132,935**	**100.0%**

Well pumpage is required to be reported to CWRM only for actual periods of pumpage. Reported well pumpage compared to sustainable yield in East Maui is minimal, with less than 0.3 % of sustainable yield pumped. While not all active wells comply with reporting requirements, and pumpage data is especially incomplete for smaller domestic and irrigation wells, there is little pressure on groundwater resources in the Hāna ASEA.

While the base year for this WUDP is 2014, alternative periods were reviewed to determine whether 2014—which exhibited a strong El Nino—is representative of consumption; and the 10-year average was determined to be consistent with the 2014 average daily demand.

Table 17-13 Consumption by MDWS Hāna System Subdistricts, 2014

ASYA/Sub-District	GPD	MGD	% of Total	Single Family (gpd)	Single Family % of Total
Kuhiwa/ Nahiku	5,745	0.006	4.32%	5,745	100.00%
Kawaipapa/ Hāna	127,190	0.127	95.68%	69,262	52.10%
Total	**132,935**	**0.133**	**100%**	**75,007**	**56.42%**

Source: MDWS Metered Consumption Data, 2014 daily average.

Table 17-14 MDWS Hāna System Comparison of Consumption Variation Over Time (gpd)

MDWS District	2014 Daily Ave	3-Yr Ave 2012-14	10-Yr Ave 2005-14	Variation 10-Yr Ave / 2014 Ave
East/Hāna	155,000	174,000	184,000	19%

MDWS Metered Consumption, 2014 is Calendar Year; other periods are fiscal year.
High year 2005-2014 ave = annual averages for 2012, 2013 and 2014. High year may vary by district.
10 year ave = annual averages, 2005-2014.

Table 17-15 MDWS Hāna System Well flow by Aquifer Sector, 2015

Well	GPM
Hamoa 1	185
Wakiu	208
Hāna Total	**393**

DOH, Safe Drinking Water Branch - July 2015.

Water consumption varies seasonally, with the low demand months generally reflecting lower outdoor irrigation demands. For the MDWS Hāna system, the seasonal fluctuations indicate the potential for outdoor water conservation as well as ways to offset use of potable water for non-potable needs. These conditions are likely to also apply to all public water systems that serve community needs.

Table 17-16 Comparison of High and Low Month by MDWS, East/Hāna DWS District, 2011 to 2015 (mgd)

District	High Month	Low Month	Variation	% Variation
East/Hāna	0.188	0.117	0.071	61%

Source: MDWS Billed Consumption (mgd). High and low months, fiscal years 2011-2015 (mgd). Agricultural Services not included. The figures for the East district are provided but are not indicative of climate conditions.

Water production is higher than consumption accounting for distribution, water losses, and unmetered use. The difference of 227,065 gpd between MDWS production (i.e. well pumpage of 360,000 gpd) and consumption (customer metered use of 132,935) is significant, and may be due to leaks in the MDWS distribution system. This represents a 63 percent rate of loss from production to end use. As shown in the following table, the 2014 and 10-year water production totals are fairly consistent.

The 2016 Hāna system water quality monitoring report shows no exceedance of drinking water standards. MDWS Hāna water systems are 100% sourced by groundwater, no surface water is used.

Table 17-17 Average Daily (AD) Production, MDWS Hāna District (East/ Hāna), 2014 (mgd)

Year	Total AD Production	Total High Month AD	Surface Water High Month AD	Groundwater High Month AD	Low Month AD Production	% Variation High/Low Month
2014	0.504	0.538	0	0.538	0.464	16%
10-Year Ave	0.380	0.610	0	0.610		31%

Source: MDWS, 2014 Calendar Year. High month production varies by district. High month consumption is August 2014. Low month AD production used as baseline to determine percent change (variation).

The MDWSs "East Maui District" includes the non-connected subsystems Keanae, Nahiku, Hāna and Kaupo. The Keanae subsystem is located within the Ko`olau aquifer sector and is addressed separately in the Ko`olau ASEA report. The Kaupo system is addressed in the Kahikinui ASEA report. Hāna and Nahiku sub-systems are described below.

<u>PWS 217: Hāna Subsystem</u>

MDWS has developed five wells in the Kawaipapa aquifer system in two well fields: Hamoa and Wakiu. One well in each well fields is for contingency back up only. The original backup well for Wakiu is no longer active and a replacement well has been developed. The wells withdraw from basal groundwater. There is no caprock along the coast. Wellhead protection assessment surveys indicate that the MDWS wells are at low risk of contamination. The majority of land in the capture zones of the wells are in forested conservation land and low intensity agriculture.

There are 402 municipal services in this system providing water service from Honokalani Road to Koali area. The average consumption for single family services in Hāna is 337 gpd, which indicates little irrigation demand. There are two agricultural services on the 4-inch line mauka of Koali area served by the Wailua stream. The municipal system is chlorinated at the storage tanks of the Hamoa and Wakiu well fields.

<u>PWS 220: Nahiku Subsystem</u>

The Nahiku area overlies the Keanae and the Kuhiwa aquifers and is an area of high rainfall, 219 inches annually at the highway and 287 inches annually at 3,100 feet. MDWS purchases water for domestic supply from the East Maui Irrigation (EMI) Company's West Makapipi Tunnel 2, Well No. 4806-07. The source is known as "Nahiku tunnel". A Memorandum of Understanding, originally entered into in 1973 and last amended in 1994, allows DWS to take up to 20,000 gpd.

Twenty-two tunnels have been driven in the Nahiku area by EMI in the 1930s and 1940s. The total yield of the tunnels during average periods was about 5.83 mgd in the 1930s. The Nahiku tunnel has supplied domestic water to Nahiku community since the 1940s. Estimated average flow in 1940 was 50,000 gpd. Average discharge per EMI data from 1932 to 1936 was 60,000 to 150,000 gpd. [42] According to EMI, the tunnel flow is currently not gaged. After MDWS withdrawals the overflow empties into Ko`olau Ditch. The intake elevation is at approximately 1,250 feet. The Department serves about 40 meters along Nahiku Road. One is classified as agricultural use and all others single family use. The tunnel water is chlorinated at the Upper Nahiku tank.

State Water Systems

There are no state water systems.

Federal Water Systems

PWS 260: Kipahulu System of the Hāna ASEA

The Kipahulu Public Water System is owned and operated by the National Park Service and serves approximately 2,000 transient non-community customers. According to the Safe Drinking Water Branch of the Hawai`i Department of Health, the Average Daily Flow is 3,000 gallons per day (gpd). Based on the reported daily flow and number of visitors, average consumption would be about 1.5 gpd per visitor.

Potable water is supplied by basal groundwater obtained from a deepwell drawing on the Kipahulu aquifer. Water is chlorinated and electricity for the well pump is generated by a photovoltaic system. There is no back up well to the Kipahulu well, with a capacity of 8,000 gpd (based on 8 hours daily pumpage). There are three storage tanks with a total capacity of 8,000 gallons. There are 4 service connections and approximately 0.5 miles of 3- and 4-inch HDPE piping, which is being replaced with 4-inch ductile iron.[43]

Private Public Water Systems

There are two private public water systems regulated by the Department of Health within the Kawaipapa ASYA of the Hāna ASEA. Both are owned by Hāna Ranch Partners, LLC and managed by the Hāna Water Systems, LLC. However, an application has been filed with the Public Utilities Commission to transfer ownership from Hāna Ranch Partners, LLC to Hāna Water Systems, LLC.

[42] Stearn & McDonald, 1946 pp 266 and 269

[43] HI DOH SDWB; CWRM; http://Hawaii.gov

PWS 201: Kawaipapa ASYA, Hāna Water Resources

Operated by Hāna Water Resources, water for this system is supplied by basal groundwater obtained from deepwells, with an Average Daily Flow of 120,000 gallons per day (gpd), according to the Safe Drinking Water Branch of the Hawai`i Department of Health.

Drinking water sources include Wananalua Well and Wakiu-Hāna Ranch Well drawing from the Kawaipapa Aquifer. Water from the wells is chlorinated. The system has one backup well with a total capacity of 288,000 gpd, based on 16 hours pumpage. Storage capacity is 500,000 gallons. The system services 88 meters distributed through 11 miles of main pipes.

The table below summarizes consumption by customer class in PWS 201:

Table 17-18 (PWS 201) Hāna Water Resources Water Consumption

Class	Average Consumption/gallons per day
Residential Use	~34,000
Commercial/Resort	~51,000
Total Consumption	~85,000

Source: HI DOH SDWB; CWRM

PWS 243: Kawaipapa ASYA , Hāna Water Company:

The second of the two privately owned public water systems within the Kawaipapa aquifer system is Hāna Water Company, owned by Hāna Ranch Partners, LLC. Water for this system is supplied by basal groundwater obtained from a deepwell, with an Average Daily Flow of 54,426 gpd. The Kaeleku-Hāna Well has a capacity of 114,240 gpd, based on 16 hours daily pumpage.

The Hāna Water Company's water supply is stored in a tri-level system of tanks with a total storage capacity of 52,500 gallons. The system services 99 meters through a distribution system of 13 miles of main pipes. Approximately 160 people are served by the Hāna Water Company. The following table summarizes consumption by customer class in PWS 243:

Table 17-19 (PWS 203) Hāna Water Company Water Consumption

Class	Average Consumption/gallons per day
Residential Use	~30,875
Commercial	~30,875
Agriculture	~3,250
Total Consumption	~65,000

Sources: HI DOH SDWB; CWRM

During a period from 2004 to 2009, one contaminant, nitrate, was found at the tap, which did not exceed the legal limit. There have been no drinking water standard violations reported for the Hāna Public Water System since 2004.

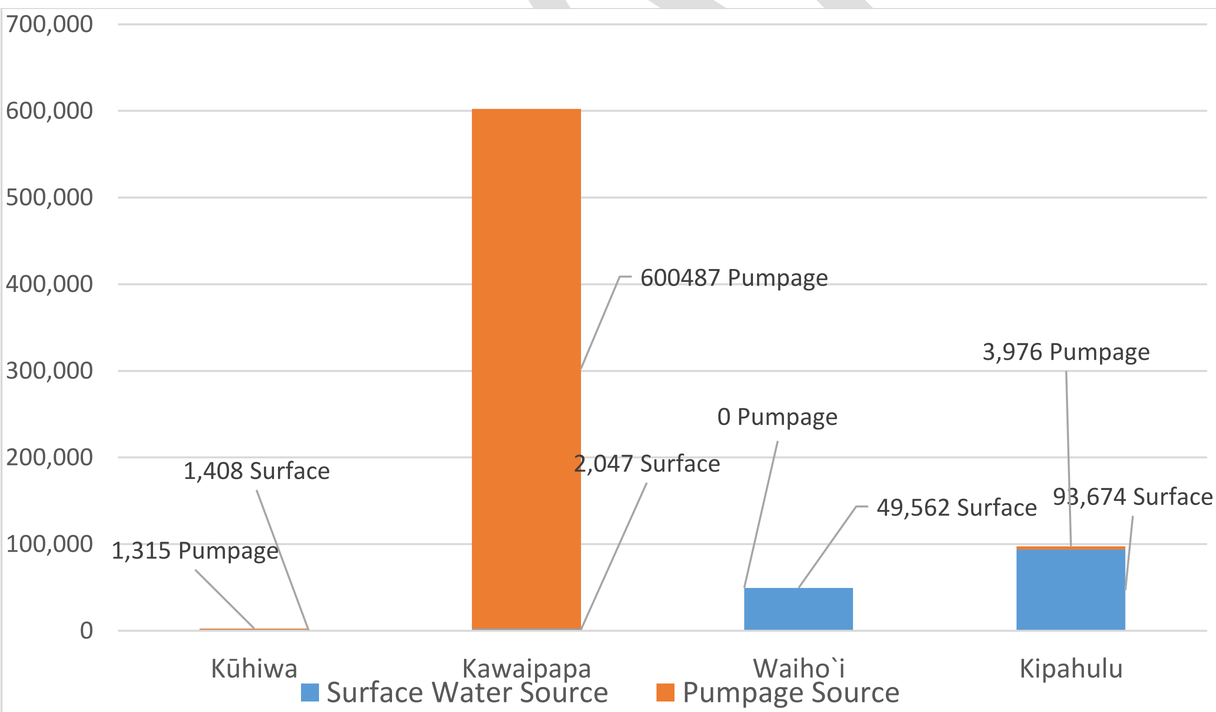
Other Potable Water Use

An unknown number of persons are not served by any public water system. Some small developments or groups of development below the DOH threshold or individual households and uses may be served by domestic wells, catchment, streams or other sources. Estimated 'order of magnitude' demand for 2014 of 0.277 mgd. The estimate is based on island-wide 2010 Census Block population of about 1,190 persons that appeared to be outside public water system purveyor service areas, general location of development and system pipes and an average MDWS per capita rate of 248 gpd.[44] Rural properties located throughout the Hāna ASEA may contain a higher proportion of unserved population compared to other areas on Maui. Rainfall is sufficient to sustain catchment systems in areas without water infrastructure.

17.5.2 Water Use by Resource

Water demand in 2014 comprised about 853,000 gpd in the Hāna ASEA, with surface water accounting for about 29 percent of total water demand and groundwater accounting for approximately 71 percent of total water demand.

Figure 17-17 Water Source by Aquifer System Area, 2014 (gpd)



Source: CWRM Well Pumpage Reports. Surface water estimated by MDWS based on CWRM 1989 Declarations of Water Use.

[44] 2010 Census Block Group population that appears to be outside public purveyor service areas – approx. 1190; apply average MDWS per capita rate of 248 gpd based on 2010-2014 consumption and interpolated population = 296,144 gpd. Excluding domestic well pumpage of 20,495 gpd results an estimated demand of 276,649 gpd.

Ground Water Resources

There are 31 wells within the sector; 28 are reported as production wells and the remaining 3 are categorized as Unused according to the CWRM database in August 2015. While well pumpage is required to be reported to CWRM not all active wells comply with reporting requirements and pumpage data is especially incomplete for smaller domestic and irrigation wells. Only a small fraction of the region's sustainable yield is developed and even less pumped. Installed pump capacity is not the permitted pumpage, but the maximum capacity of the permitted well in gallons per minute multiplied by 24 hours. Sustainable Yield is given in million gallons per day while pump capacity and pumpage is given in gallons per day in the table below.

Table 17-20 Pumpage and Pump Capacity of Wells Compared to Sustainable Yield (SY), Hāna ASEA (2014)

	Pumpage (GPD)						Pump Capacity (GPD)	
Aquifer System/SY (MGD)	**MDWS**	**Private Public Municipal**	**Domestic**	**Irrigation**	**Total**	**As % of SY**	**Installed**	**% of SY**
Kuhiwa (14)	5,745	0	0	1315	7,060	0.05%	36,000	0.26%
Kawaipapa (48)	444,264	156,223	0	0	600,487	1.25%	2,424,000	5.05%
Waiho`I (18)	0	0	0	0	0	0.00%	69,000	0.38%
Kipahulu (42)	0	3,000	3,976	0	6,976	0.02%	815,000	1.94%
Total (122)	**450,009**	**159,223**	**3,976**	**1,315**	**614,523**	**0.50%**	**3,344,000**	**2.74%**

Source: CWRM Well Index 5/29/2015 for production wells and 2014 pumpage reports, 12-month moving average.

Surface Water Resources

Surface water is diverted for a variety of purposes; however, surface water diversion data reported to CWRM for the Hāna ASEA is very limited, other than the 1989 Declarations of Water Use already described in this report.

There are no CWRM stream diversion gages located within the Hāna ASEA. However, there is a CWRM gage located at Makapipi Stream within the Ko`olau ASEA, which is a source for the Nahiku MDWS Water System located within the Hāna ASEA. Diversions registrations and available data is summarized in the table below. Registered quantities are in million gallons per year (MGY), totaling 53.5 MGY. The figure illustrates location of diversions throughout the aquifer sector.

Table 17-21 Hāna ASEA Registered Surface Water Diversions

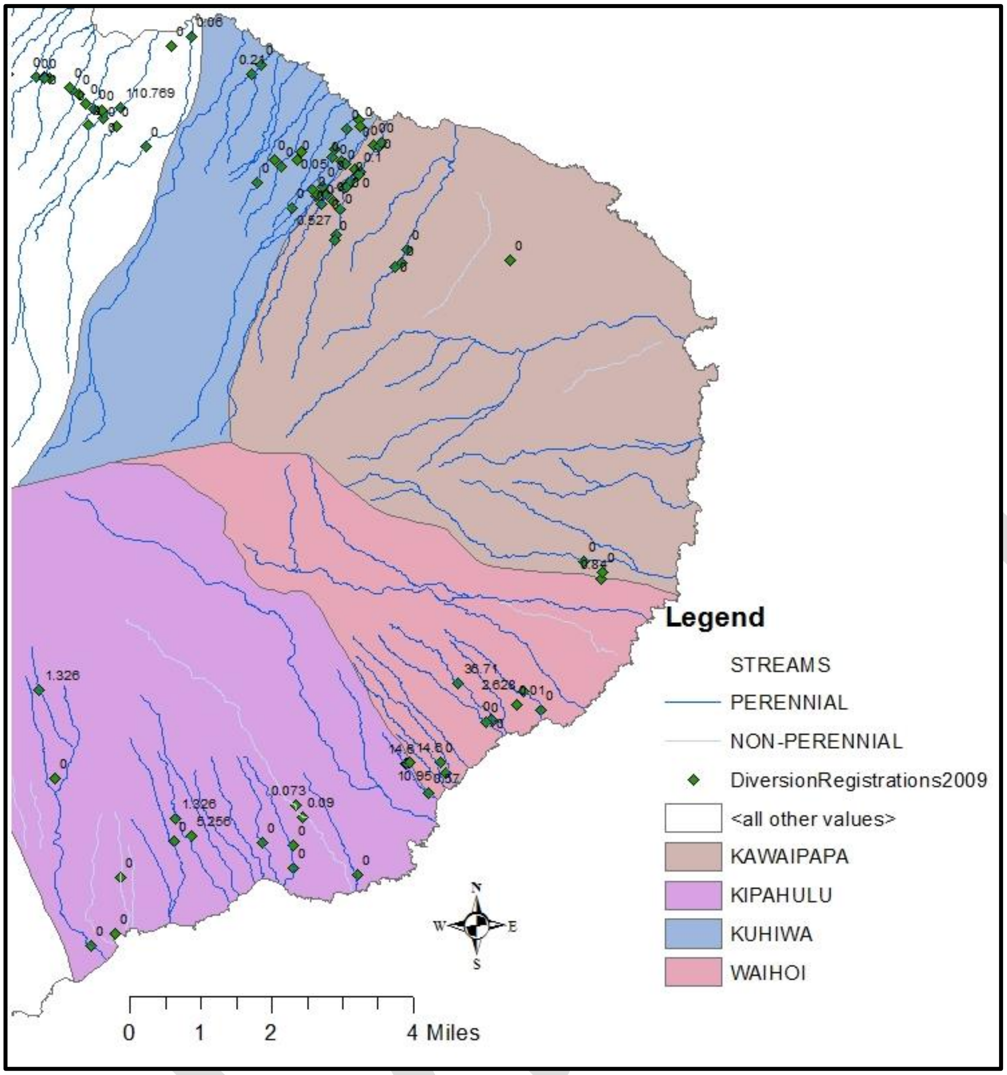
AQUIFER SYSTEM	Description	Q (MGY)	HYDROLOGIC UNIT	LOCATION
KAWAIPAPA	Spring diversion, pump from Ho`opai Trough.	0.000	Heleleikeoha	Kawakoe Gulch
KAWAIPAPA	Stream diversion, pipe from Unnamed stream. Three different maps are provided in the file with discrepancies as to the location of intake.	0.000	Heleleikeoha	Unmapped
KAWAIPAPA	Stream diversion, pipe from Honomaele Gulch (new entry).	0.000	Honomaele	Honomaele Gulch
KAWAIPAPA	Stream diversion, pipe from Honomaele Gulch. Filed in PARKER S file.	0.000	Honomaele	Honomaele Gulch
KAWAIPAPA	Spring diversion, taro lo`i, ditch, and rights claim.	0.000	Honomaele	Unmapped
KAWAIPAPA	Stream diversion, hose & bucket from Kapia Stream.	0.000	Kapia	Kapia
KAWAIPAPA	Stream diversion, from Kapia Stream tributary.	0.000	Kapia	Unmapped Tributary to Kapia
KAWAIPAPA	Stream diversion, pipe from Kawakoe Gulch.	0.100	Kawakoe	Kawakoe Gulch
KAWAIPAPA	Stream diversion, pipe from Kawakoe Stream.	0.000	Kawakoe	Kawakoe Gulch
KAWAIPAPA	Stream diversion, from Kawakoe Stream (new entry).	0.000	Kawakoe	Kawakoe Gulch
KAWAIPAPA	Stream diversion, pipe from Mokulehua Stream.	0.000	Kawakoe	Kawakoe Gulch
KAWAIPAPA	Stream diversion, pipe from Kawakoe Gulch Stream. SYKOS S&L is an end user and co-operator.	0.000	Kawakoe	Kawakoe Gulch
KAWAIPAPA	Stream diversion, pipe from Mokulehua Stream.	0.527	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Stream diversion, 2 pipes from Mokulehua Stream.	0.000	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Stream diversion, from Mokuleia Stream diversion. Location of water use is probably on parcel #14.	0.000	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Stream diversion, from Mokulehua Stream (new entry).	0.000	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Stream diversion, from Mokulehua Stream (new entry).	0.000	Kawakoe	Mokulehua Gulch

KAWAIPAPA	Stream diversion, from Mokulehua Stream (new entry).	0.000	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Stream diversion, from Mokulehua Stream (new entry).	0.000	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Stream diversion, pipe from Mokulehua Stream.	0.120	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Spring diversion, pipe from Unnamed spring.	0.000	Kawakoe	Mokulehua Gulch
KAWAIPAPA	Stream diversion, from Kawakoe Stream (new entry).	0.000	Kawakoe	Unmapped Tributary to Kawakoe Gulch
KIPAHULU	Stream diversion, pipe from Pu\`ualu\`u Stream.	0.000	Kalena	Kalena
KIPAHULU	Stream diversion, Kalepa Intake from Kalepa Gulch. Method for determining quantity of use not provided.	1.326	Kalepa	Kalepa Gulch
KIPAHULU	Stream diversion, pipe from Kalepa Stream tributary. Q was estimated from pipe output.	5.256	Kalepa	Unmapped Tributary to Kalepa Gulch
KIPAHULU	Stream diversion, pipe from Koukouai Stream. Declared Q was measured with bucket and stop watch.	0.090	Koukouai	Kaukauai Gulch
KIPAHULU	Stream diversion, pipe from Kaukauai Stream.	0.073	Koukouai	Kaukauai Gulch
KIPAHULU	Stream diversion, probably hand-carry from Kukuiula Stream for irrigation. No diversion structure.	0.000	Kukuiula	Kukuiula Gulch
KIPAHULU	Stream diversion, pump from Manawainui and rights claim.	0.000	Manawainui	Manawainui
KIPAHULU	Stream diversion, from Panileihulu and Healani Streams. Method for determining quantity of use not provided.	1.326	Manawainui	Tributary to Manawainui
KIPAHULU	Spring diversion, pump from Manawainui Spring.	0.000	Manawainui	Unnamed Spring
KIPAHULU	Spring diversion, pipe from Pa\`anene and rights claim.	0.000	Nuanua\`aloa	Pa\`anene Spring
KIPAHULU	Spring diversion, pump from Punahoa Spring.	0.000	Nuanua\`aloa	Punahoa Spring
KIPAHULU	Spring diversion, pipe from Maili Spring and rights claim.	0.000	Nuanua\`aloa	Unmapped Spring
KIPAHULU	Stream diversion, pump from Opelu Stream and rights claim.	0.000	Opelu	Opelu Gulch
KIPAHULU	Stream diversion, from seepage with pipe.	0.000	Opelu	Unmapped Spring
KIPAHULU	Stream diversion, pipe from Puaalu\`u Stream.	0.570	Pua\`alu\`u	Pua\`alu\`u Gulch

KIPAHULU	Stream diversion, pipe from Pua`alu`u Stream. According to info in the KIPAHULU HUI file, the ASSOC gets water from TMK 1-5-11:07. Method for determining quantity not provided.	10.950	Pua`alu`u	Pua`alu`u Gulch
KIPAHULU	Spring diversion, pipe from Unnamed spring. Q was estimated with 5-gallon bucket. Declared Q or 14.600 MG is the total for both of declarant's diversions.	14.600	Pua`alu`u	Unmapped Spring
KUHIWA	Stream diversion, hand carry from Heleleikeoho Stream and rights claim.	0.000	Heleleikeoha	Heleleikeoha
KUHIWA	Stream diversion, hand carry from Heleleikeoho Stream and rights claim.	0.000	Heleleikeoha	Heleleikeoha
KUHIWA	Stream diversion, from Heleleikeoha Stream.	0.050	Heleleikeoha	Heleleikeoha
KUHIWA	Stream diversion, pipe from Heleleikeoho Stream. Filed under ESTOCADO WWP.	0.000	Heleleikeoha	Heleleikeoha
KUHIWA	Stream diversion, hand carry from Kakamalaole Stream and rights claim.	0.000	Heleleikeoha	Unmapped
KUHIWA	Spring diversion, hand carry from Unnamed stream and rights claim.	0.000	Heleleikeoha	Unmapped Spring
KUHIWA	Spring diversion, pipe from Unnamed Stream. May be unused or intended.	0.000	Heleleikeoha	Unmapped Spring
KUHIWA	Stream diversion, hand carry from Kakamalaole and rights claim.	0.000	Heleleikeoha	Unmapped Tributary to Heleleikeoha
KUHIWA	Stream diversion, carry from Koala`alaole and rights claim.	0.000	Heleleikeoha	Unnamed
KUHIWA	Stream diversion, hand carry from Koala`alaole Stream and rights claim.	0.000	Heleleikeoha	Unnamed
KUHIWA	Stream diversion, from unnamed stream and rights claim. See also new entries.	0.000	Heleleikeoha	Unnamed
KUHIWA	Stream diversion, pipe from Koala`alaole Gulch. Declared Q is the total amount used from 4 diversions, however, three of these appear to be end uses.	0.204	Heleleikeoha	Unnamed
KUHIWA	Stream diversion, pipe from Unnamed stream. May be unused.	0.000	Keaaiki	Keaaiki Gulch
KUHIWA	Stream diversion, pipe from Keaaiki Tributary.	0.000	Keaaiki	Unmapped Tributary to Keaaiki Gulch
KUHIWA	Spring diversion, from unmapped spring-fed pond.	0.050	Lanikele	Unmapped Spring/Pond
KUHIWA	Stream diversion, pipe from Kahalaoka Gulch.	0.210	Waihole	Waihole Gulch

KUHIWA	Stream diversion, pipe from Waihole Stream.	0.000	Waihole	Waihole Gulch
KUHIWA	Stream diversion, pipe from Waione Stream and rights claim.	0.000	Waioni	Unmapped Tributary to Waioni Gulch
KUHIWA	Stream diversion, pipe from Waioni Stream and rights claim.	0.000	Waioni	Waioni Gulch
WAIHO`I	Stream diversion, auwai from A`alaula Stream and rights claim.	0.000	Ala`alaula	Ala`alaula Gulch
WAIHO`I	Spring diversion, pipe from Unnamed spring. Q was estimated with a bucket and stop watch.	2.628	Ala`alaula	Unmapped Spring
WAIHO`I	Stream diversion, pipe from Hahalawe Gulch.	0.000	Hahalawe	Hahalawe Gulch
WAIHO`I	Stream diversion, pipe from Kakiweka Stream.	0.012	Kakiweka	Unmapped Pond
WAIHO`I	Stream diversion, pipe from Kapia Tributary. Q was estimated with a meter.	0.840	Kapia	Unmapped Tributary to Kapia
WAIHO`I	Spring diversion, pipe from Unnamed spring. Q was estimated with 5-gallon bucket. Declared Q or 14.600 MG is the total for both of declarant's diversions.	14.600	Puaalu`u	Unmapped Spring
WAIHO`I	Stream diversion, from Unnamed Spring. Declared Q was estimated from a 5-gal bucket. While the diversion is located within the Wailua Watershed, the property is also within the Ala`alaula Watershed.	0.010	Wailua	Unmapped Spring
WAIHO`I	Stream diversion, auwai from Unnamed stream and rights claim.	0.000	Wailua	Wailua
WAIHO`I	Stream diversion, pipe from Wailua Stream. May be unused or intended.	0.000	Wailua	Wailua
	TOTAL	**53.542**		

Figure 17-18 Hāna ASEA Registered Surface Water Diversions



Alternative Water Resources

Rainwater Catchment

Rainwater catchment is the collection of rainwater from a roof or other surface before it reaches the ground. Rainfall ranges from 60-400 inches per year in Hāna.[45] Rainwater catchment is not as reliable a conventional water resource because it is extremely sensitive to the climate; however, rainwater catchment is a viable option in this region. Rainwater catchment systems are not regulated by the Department of Health, making estimates of their use difficult. No inventory of installed catchment systems throughout the island is available.

---

[45] Johnson, A.G., Engott, J.A., and Bassiouni, Maoya, 2014, Spatially distributed groundwater recharge estimated using a water-budget model for the Island of Maui, Hawai'i, 1978–2007: U.S. Geological Survey Scientific Investigations Report 2014–5168, 53 p., http://dx.doi.org/10.3133/sir20145168.

Stormwater Reuse

There is no reported stormwater reuse within the Hāna ASEA, although a limited number of development projects may have stormwater controls incorporated into project design to reduce runoff and its effects. Stormwater reuse at the parcel scale may also provide an opportunity to offset landscape and other irrigation demand of projects or households.

Desalination

Desalination of ocean or brackish water was studied as an option in the 2013 MDWS study, Maui Island Water Source Development Options for the Central MDWS system, but an assessment has not been conducted for the Hāna ASEA, and there are presently no desalination projects within. One major cost to operate a desalination plant is the high energy demand of the process, and the disposal of the brine liquid byproduct creates logistical and environmental challenges that also increase cost. As desalination technology advances and energy costs decrease, brackish and ocean water desalination should continue to be evaluated for their potential as effective future water supply alternatives.

17.6 FUTURE WATER NEEDS

17.6.1 General

Two alternative methods were used to project water demand to the year 2035: Population growth rates based on 20-year population growth projections in the Socio-Economic Forecast Report (2014) applied to current consumption and build-out of permitted land use based on County zoning and Department of Hawaiian Homelands land use plans. Population based demand takes into account social and economic factors that are anticipated to drive growth over the planning period.

17.6.2 Water Use Unit Rates

The 2002 Water Use Standards are used for land use based demand projections. Most of the water use in the Hāna ASEA is for residential or single-family use; the 2002 Standards for residential use is 600 gallons per day (gpd) per unit and 3,000 gpd per acre for single family/duplex and 5,000 gpd per acre for multi-family use. System standards factor in outdoor use and are generally higher than empirical use in the region, as irrigation needs are relatively low.

The Maui Island Plan projects a minimal 20-year population increase from 2015 to 2035 for the Hāna Community Plan area, which includes all of the Hāna Aquifer Sector Area (ASEA), part of the Kahikinui ASEA, and some of the Ko`olau ASEA. However, the Kahikinui and Hāna ASEAs' population growth rate is expected to be even less than the larger Hāna Community Plan's minimal 20-year projection. According to the County of Maui Planning Department's Long-Range Planning Division's 2014 Final Draft Socio-Economic Forecast projected population growth estimates, the population and water demand for the East Maui region is anticipated to grow by 22 percent between 2015 to 2035; therefore, water demand based on population for the Hāna ASEA is also projected to increase by 22.

17.6.3 Land Use Based Full Build-Out Water Demand Projections

Full build-out projections for the Hāna area based on County zoning and DHHL land use categories yield a projected water demand of 65,416,545 gpd, or 65 million gallons per day. Full build out by county zoning designation is neither realistic over the planning period or supported by the county general plan. System standard water rates for agricultural zoning are theoretically assigned but do not represent regional irrigation needs.

<u>Maui County Zoning</u>

Maui County Zoning for the Hāna ASEA includes predominantly Agriculture and to a lesser extent Interim Use Zone Districts. Interim zoned land (mostly Conservation) was assigned a zone based on Directed Growth Plan guidance and Community Plan land use designations in order to calculate water demand. There are over 56,521 zoned acres in the Hāna ASEA (excluding DHHL lands [743 acres]). The Interim District encompasses 38,378 acres. The Hāna Community Plan assigns the following land use designations to the 38,378 Interim zoned acres: Light Industrial (9.13 acres); Airport (60.93 acres); Park (290.71 acres); Road (12.05 acres); Single Family (89.77 acres); Multi-Family (6.01 acres); Agriculture (27.97 acres); Rural (538.20 acres); Open Space (52.47 acres) Conservation (37,236.70 acres); Public/Quasi-Public (65.93 acres). Interim zoned areas that are designated by the Hāna Community Plan as Conservation, Open Space, Unzoned Road, and Urban Reserve are all assigned to the "Open Space" zoning district, with no water demand associated with their use. There is a remaining balance of 259 Interim zoned acres that is unassigned to another land use designation by the Community Plan. A summary of the County land use based demand follows a discussion of DHHL land use based demand. Percentage zoned acres of total is rounded.

Table 17-22 Summary of Zoning Use Types, Hāna ASEA (Excluding DHHL Lands)

Zoning Summary (Corresponding County Zoning Categories found within the Hāna ASEA in Parentheses)	**Acres**	**% of Total**	**Water Use Rates (gpd per acre)**
Single Family, Duplex (R-3 Residential, RU-0.5 Rural - 1/2 Acre, Service Business Residential)	681.36	1.21%	3,000
Apartment, Multifamily (A-1 Apartment)	6.80	0.01%	5,000
Hotel (H-1 Hotel)	20.28	0.03%	17,000
Business (B-2 Business - Community, SBR - BCT Business - Country Town)	22.48	0.03%	6,000
Industrial (M-1 Light Industrial)	9.13	0.02%	6,000
Airport	60.93	0.11%	6,000
Agriculture (AG Agriculture)	17,508.67	31.00%	3,400
Golf Course (PK-4 Park - Golf Course)	191.80	0.34%	1,700
Public/Quasi-Public (P-1 Public/Quasi-Public)	116.92	0.21%	1,700
Park (PK-2 Park – Community, PK-3 Park – Regional)	298.57	0.53%	1,700
Open Space** (Conservation, Open Space, Unzoned Road, Urban Reserve)	37,382.16	66.04%	0
Interim***	259.42	0.46%	
TOTAL excluding DHHL Lands**	56,521	100%	

Source: Table prepared by MDWS, Water Resources & Planning Division. Excludes DHHL lands.
Zoning supplied by Maui County Planning Department, Long Range Division, May 2015.
Interim zoning was assigned to CWRM categories based on Community Plan land use designations.
*Includes Community Plan designations of Open Space and Conservation designated "Interim" in County zoning.

**Acreage represents the difference between County zoning and Community Plan designations for "Interim": 259 acres were designated "Interim" in County zoning, but not designated a Community Plan use type, and therefore, remained undesignated "Interim" County zoning. Additionally, some "interim" zoned areas may not have a community plan land use designation due to the GIS analysis omitting a narrow band along the coastline due to slightly different geocoordinates between GIS layers' boundaries.
***The balance of 259 Interim acres remains unassigned to another land use designation by the Community Plan.
****743 acres of DHHL lands zoned Agriculture excluded from Agricultural zoning category.

State Department of Hawaiian Home Lands (DHHL)

DHHL maintains land use jurisdiction over Hawaiian Homes and are not subject to county zoning designations. DHHL zoned lands are not accounted for in Table 17-22 above. Water rates used by the State Water Projects Plan Update; DHHL, May 2017, are as follows;

Table 17-23 DHHL Land Use, Water Standards for Maui

Land Use	Potable	Nonpotable
Residential	600 gal/unit	None
Subsistence Ag	600 gal/unit	3400 gal/acre
Supplemental Agriculture	None	3400 gal/acre
Pastoral	600 gal/unit	20 gal/acre
General Ag	None	3400 gal/acre
Special District	Varies	Varies
Community Use acres	1,700 gal/acre or 60 gal/student	None
Conservation	None	None
Commercial	3,000 gal/acre or 140 gal/1,000 SF	None
Industrial	6,000 gal/acre	None

Source: DHHL Maui Island Plan

Projected demand based on the DHHL Maui Island and regional land use plans are summarized below for 743 acres zoned Agriculture by the County of Maui.

Table 17-24 Hāna ASEA DHHL Lands Excluded from Zoning

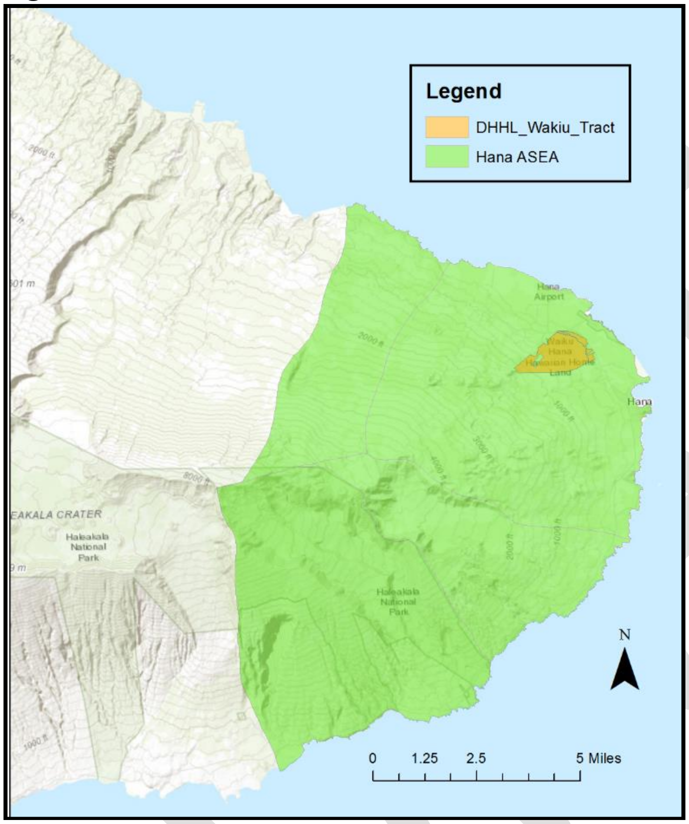
TOTAL DHHL ACRES	LAND USE DESIGNATION: AG (ACRES)	WATER STANDARDS/ACRE	TOTAL WATER DEMAND (GPD)
743	743	3,400	2,526,200

Source: Table prepared by DWS, Water Resources & Planning Division.

Interim and Project District zoning assigned to zoning districts based on Community Plans and Development Projects.

The 2017 State Water Projects Plan (SWPP) has been updated to address DHHL's project needs from 2016 to 2031.[46] There are four DHHL project areas in the East Maui region (Kahikinui, Keanae, Wailua, and Hāna), with the 743 acre DHHL Wākiu Project as the only DHHL project located within the Hāna ASEA. Projected water demand and strategies for build-out of the Wākiu Project over the WUDP planning period is discussed under Population Growth Based Water Demand below.

Figure 17-18 DHHL Wākiu Tract, Hāna ASEA



The following table summarizes County and DHHL land use/zoning based demand.

---

[46] State of Hawai`i Department of Hawaiian Homelands, State Water Projects Plan Update, 2017

Table 19-25 Full Build-Out Water Demand Projections by CWRM Use Type, Hāna ASEA

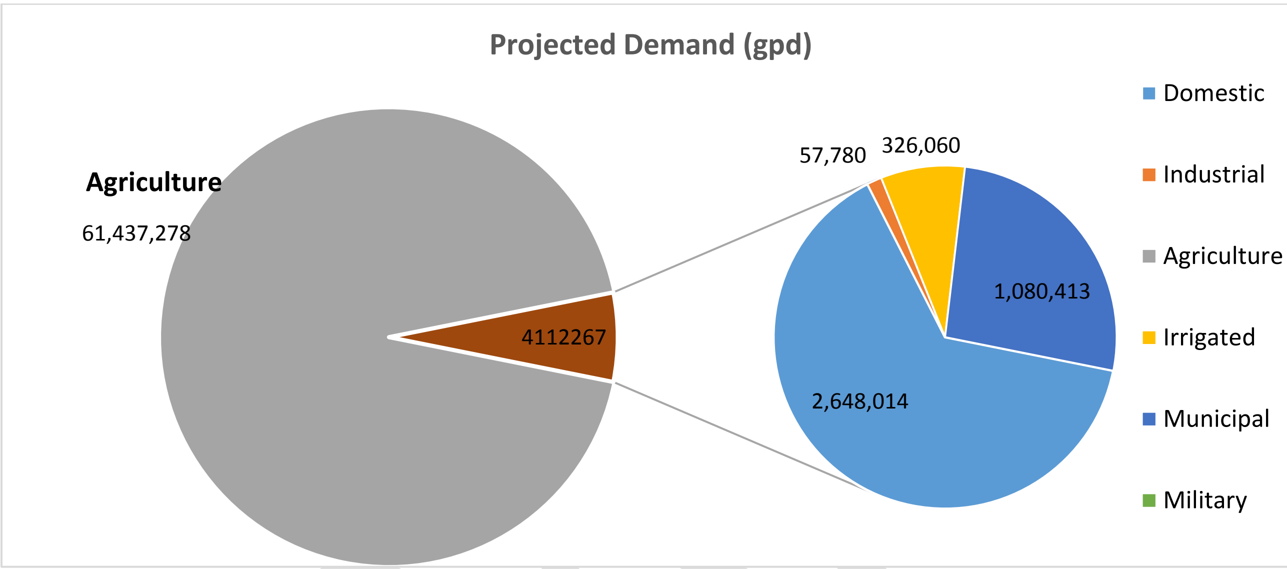
CWRM Use Categories	County Zoning Based			DHHL Land Use Category Based				Total Projected Demand (mgd)
	Acres	Projected Demand (gpd)	Water Use Rate (gpd)	DHHL Land Use	Acres / Res Units	Water Use Rate (gpd)	Projected Demand (gpd)	
Domestic-Residential *	689.68*	2,082,640	3,000-5,000*	Residential *****	121/117	600 gal/unit	70,200	**2,152,840 (unit-based)**
Domestic Non-Residential **	42.79**	480,174	6,000 gal/acre	Commercial	5	3,000 gal/acre	15,000	495,174
Industrial	9.13	54,780	6,000 gal/acre	Industrial	5	6,000 gal/acre	3,000	**57,780**
Agriculture	17,508.67	59,529,478	3,400 gal/acre	Agriculture	522	3,400 gal/acre	1,774,800	**61,304,278**
Open Space	37,382	0	0	Open Space[47]	85	0	0	**0**
Irrigated***	191.80***	326,060	1,700	N/A	N/A	N/A	N/A	**326,060**
Municipal****	476.42 ****	1,071,913	1,700 gal/acre	Community	5	1,700 gal/acre	8,500	**1,080,413**
Military	0	0		N/A	N/A	N/A	N/A	**0**
Total	**18,918.49**	**63,545,045**			**743**		**2,004,500**	**65,549,545**

Source: MDWS Water Resources & Planning Division. Figures may not add due to rounding. Open space, conservation/cultural protection and similar land use types not included due to lack of water demand.
County Zoning: Based on zoning supplied by Maui County Planning Department, Long Range Planning Division, May 2015. DHHL lands are excluded.
DHHL Lands: Based on DHHL Maui Island Plan and Regional Plans. Future land uses are unknown for some lands.
*2,082,640 gpd Domestic-Residential--potable and non-potable needs: (1) Single Family Residential Duplex, Rural, Residential-3, SBR - Service Business Residential (682.88 acres x 3,000 gpd/acre standard) = 2,048,640 gpd); (2) A-1 Apartment, Multifamily Residential (6.80 acres x 5,000 gpd/acre standard) = 34,000 gpd
** Domestic Non-Residential--potable and non-potable needs (480,174 gpd): (1) Business (B-2 Business – Community, BCT Business - Country Town [22.48 acres x 6,000 gpd standard = 134,904 gpd]); (2) Hotel (20.31 acres H-1 Hotel x 17,000 gpd standard = 345,270 gpd)
***"Irrigated" (326,060 gpd) includes ONLY PK-4 Park-Golf Course (191.80 acres x 1,700 gallons per acre standard = 326,060 gpd)
**** Municipal water as defined by CWRM) (1,071,913 gpd) is zoned as: (1) Interim-zoned/CP designated "Airport" (60.93 acres x 6,000gpd/acre standard = 365,580 gpd); (2) "Public," Interim-zoned/CP designated, "Public/Quasi-Public" (116.92 x 1,700 gpd standard = 198,764 gpd); (3) PK-2 Park - Community, PK-3 Park - Regional zoning

[47] Open Space acreage for DHHL is the unaccounted for balance of total of 743 designated acres for the Wakiu Tract minus the designated uses identified in the 2004 DHHL Maui Island Plan.

districts (298.57 acres x 1,700 gpd standard = 507,569 gpd); and Municipal is likely to serve Domestic Residential zoned areas
*****The proposed land use for Wakiu includes 46 acres of one-half acre residential lots and 75 acres of three-acre subsistence agricultural lots (DHHL Maui Island Plan, 2004, page 6-9)

Figure 17-19 Full Build-Out Water Demand Projections by CWRM Use Type, Hāna ASEA



State Water Projects Plan

The State Water Projects Plan 2017 update only addressed Department of Hawaiian Homelands projects. Other state projects are addressed in the adopted 2004 SWPP. Availability of water required for state projects, excluding DHHL, can be determined through the year 2020 based on the 2004 SWPP Report. Land use-based water demand projections are compared to those in the 2004 SWPP, which projects future water demand to 2020, shown in the table below. According to the SWPP, Hāna ASEA non-DHHL potable demand in 2018 is anticipated to be 5,680 gpd, with no anticipated non-potable demand.[48] The projects are additional use at the high school and airport and accounted for within the population-based projections for Hāna ASEA.

Table 17-26: State Water Projects Plan Projected Water: Hāna ASEA Demands to 2018 (Excludes DHHL Projects)

ASEA	ASYA	2018 Non-Potable Demand (gpd)	2018 Potable Demand (gpd)	2018 Total Demand (gpd)
Hāna	Kawaipapa	0	5,680	5,680

State Water Projects Plan, Hawai`i Water Plan, Volume 4, SWPP for Islands of Lanai/Maui/Moloka'i, 2003.

[48] State Water Projects Plan, Hawai`i Water Plan, Volume 4, SWPP for Islands of Lanai/Maui/Moloka'i, 2003, page 3-10

Agricultural Water Use and Development Plan (AWUDP)

The 2004 Agricultural Water Use and Development Plan (AWUDP) addressed the East Maui Irrigation System and related agricultural irrigation demand sourced from Ko`olau aquifer sector for use in Central and Upcountry Maui. The AWUDP does not address agricultural use and projections for the Hāna ASEA.

17.6.4 Population Growth-Based Water Demand Projections

Population growth rate projections were applied in 5-year increments over the 20-year planning period from 2015 to 2035 for high, medium (base case) and low growth scenarios. Water use for both county and privately owned public water systems, are compared to the incremental water needs for the next 20 years based on the 2014 *Socio-Economic Forecast Report* prepared by the Planning Department and consistent with the Maui Island Plan. Water use and demand based on population growth rates do not account for large-scale agricultural irrigation needs. It's assumed that projects described in the 2004 State Water Projects Plan, excluding DHHL, are accounted for by the population projections. Therefore, information from this document was not used to further refine the population-based demand projections. DHHL projection for build-out of the Wakiu tract is added to population growth based demand as it was not specifically addressed in the Maui Island Plan or socio-economic forecast.

The Maui Island Plan projects a 22 percent population increase between 2015 and 2035 for the Hāna ASEA based on the community plan growth rates in the Socio-Economic Forecast. Water demand (excluding large agriculture and irrigation needs) is also projected to increase by 22 percent from 862,472 gpd to 1,052,440 gpd over 20 years. The greatest need is for single-family residential use.

Table 17-27 Projected Population-Based Water Demand for Hāna ASEA

Criteria	2010	2014	2015	2020	2025	2030	2035	20-Year Increase
% Increase	N/A	N/A	5.5%	5.11%	5.10%	5.08%	5.12%	22.04%
Population	2,081 *	2,173	2,196	2,308	2,426	2,549	2,680	484
Water Demand (gpd)		853,044**	862,472	906,544	952,778	1,001,179	1,052,440	189,968

Source: 2014 Final Draft Socio-Economic Forecast, Maui County Planning Dept., Long Range Planning Division. Water Demand projected by Maui County MDWS, Water Resources & Planning, 2016

*2,081 is the population of the Hāna ASEA based on the 2010 Census. The Hāna Community Plan Area in comparison had a population of 2,291 based on the 2010 Census.

** includes water use from stream diversions that is used for domestic purposes. It is unknown what proportion of the domestic use is for potable versus non-potable uses. This figure also includes a small amount of irrigation well water usage.

The table below indicates 3 different scenarios for increasing water demand into the future: (1) the base case is the expected growth rate (between 5.08% and 5.5% increases); (2) A high-growth scenario (7.9% increase); and (3) a low-growth scenario (8.6% decrease).

Table 17-28 Projected Low, Base and High Population Based Water Demand to 2035, Hāna ASEA (gpd)

Case	2015	2016	2017	2018	2019	2020	2025	2030	2035
Base Case	862,472	871,287	880,101	888,916	897,730	906,544	952,778	1,001,179	1,052,440
High Case	862,472	940,118	949,629	959,140	968,651	978,162	1,028,048	1,080,273	1,135,583
Low Case	862,472	796,356	804,412	812,469	820,525	828,582	870,839	915,078	961,930

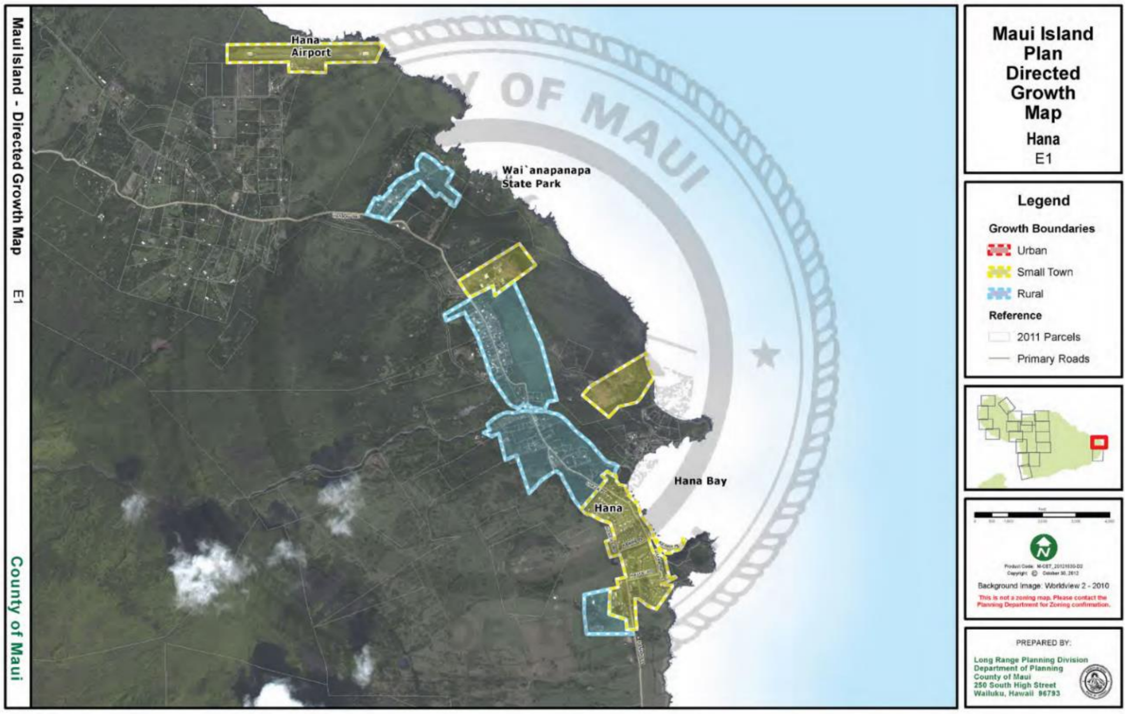
Source: MDWS, 2017.

Population Growth Based Demand in Planned Growth Areas

The Maui Island Plan includes the Hāna Affordable Residential planned growth area with a full build out of approximately 200 affordable residential units and community facilities. It is expected that population growth will be focused within country town and rural growth boundaries where existing infrastructure can indicate which water resources and purveyors are available to serve a development.

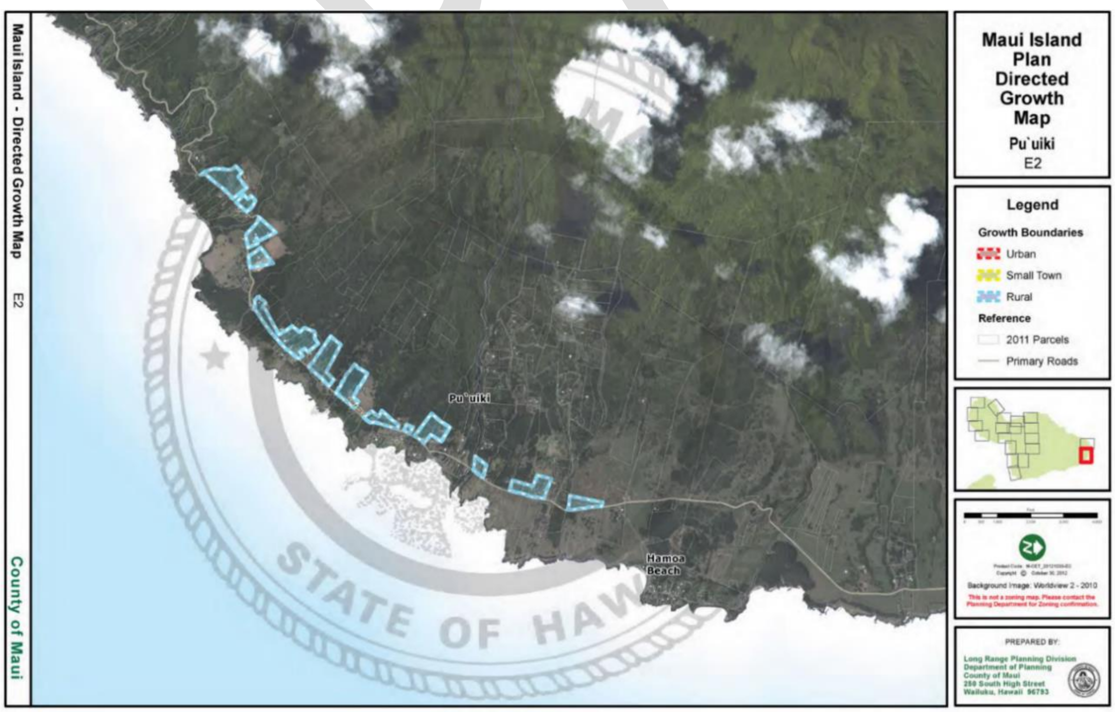
The Hāna ASEA consists of mostly rural residences and Hāna Town, a small town about a mile long surrounded by rural suburbs. "Country Town" growth designations are scattered from Hāna Town north along Hāna Highway for approximately five miles. Rural Service Center growth designations extend north from Hāna Town approximately two miles. Another Rural Service Center area extends from Hamoa south approximately three miles. The MDWS Hāna Water System supplies approximately 59 percent of overall potable water production within the Hāna ASEA; the MDWS Nahiku Water System produces approximately 8 percent of overall potable water production within the Hāna ASEA; Haleakala National Park produces approximately one percent of the overall potable water production within the Hāna ASEA; and private municipal water services produce approximately 32 percent of overall potable water production within the Hāna ASEA: Hāna Water Resources (22%); Hāna Water Company (10%).

Figure 17-20 Hāna Planned Growth Areas, Maui Island Plan Directed Growth Map E1: Hāna Town to Hāna Airport



The directed growth areas from Hamoa to the Kipahulu consist entirely of Rural growth boundaries.

Figure 17-21 Pu`uiki Planned Growth Areas, Hamoa to Kipahulu



Development Projects List

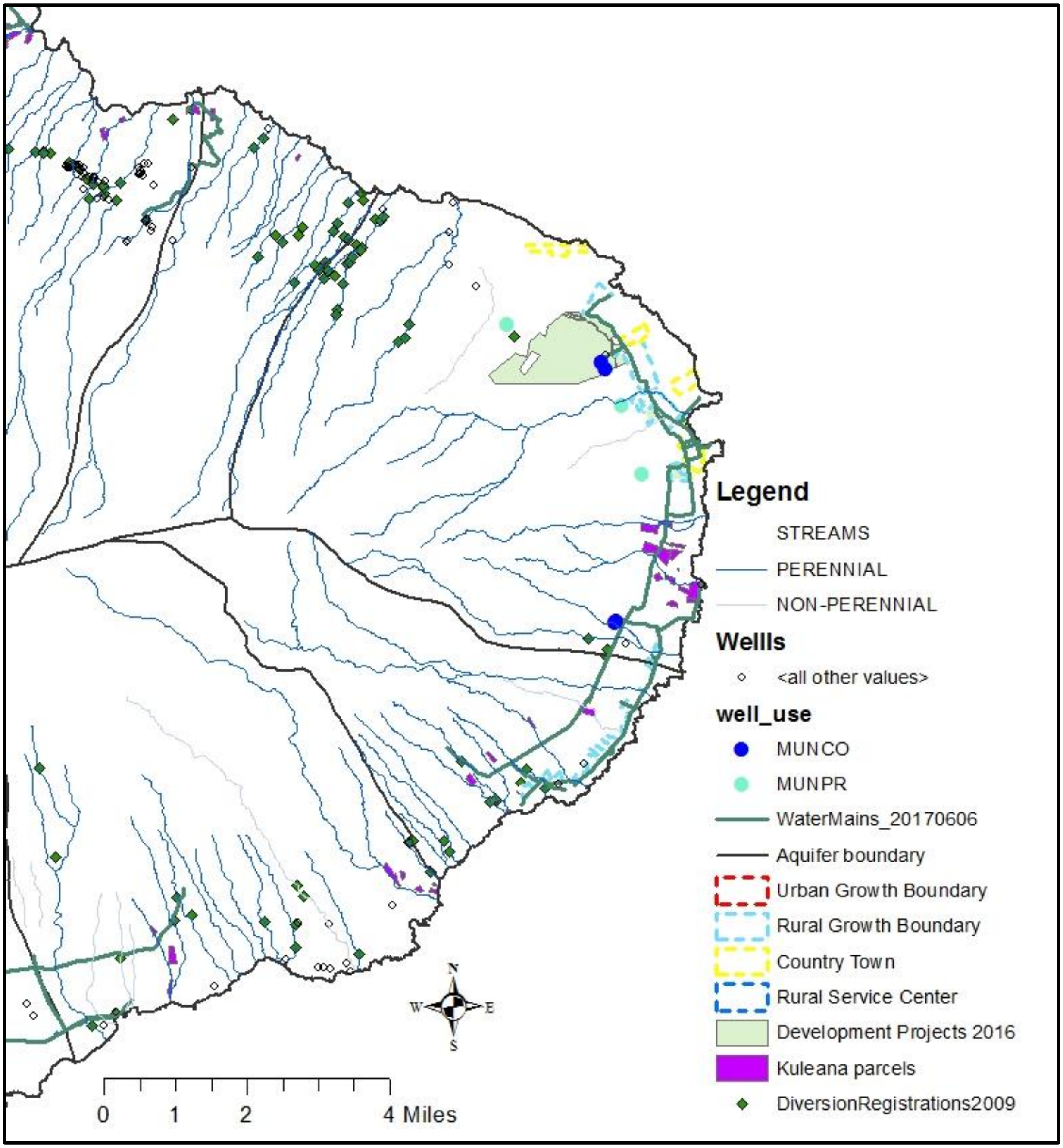
The Planning Department maintains a list of large development projects that have come to their attention, some of which have been entitled, committed or are supported by the Maui Island Plan but not necessarily the Community Plan. Development projects located within the Hāna ASEA include 102 homes planned for DHHL's Wakiu Hāna Homes Project, 43 homes at Hāna Ranch Affordable Housing, 21 units at Hāna Community Health and Wellness Village, and the Hāna Ranch Store Project. The map below shows the Growth Boundaries, public water systems, groundwater wells, registered surface water diversions, and the location of projects on the 2016 Development Projects list. Projected demand to serve the 2016 list alone, based on dwelling units, is 109,500 gpd. While projects may not be approved as proposed, or constructed once approved, the List is instructive as to location and planning for water sources. The population growth based demand is compared to the demand representing know Development Projects in the table below.

Table 17-29 Population Based Demand 2035 Compared to 2016 Development Projects List (mgd)

Hāna Aquifer System Area	2035 Demand	2016 Development Projects List		
		Entitled	Not Entitled MIP and/or CP	Total
Kawaipapa	0.35	0.072	0.0375	0.1095
Kuhiwa	0.01	0	0	0
Waiho`i	0	0	0	0
Kipahulu	0	0	0	0
Total	**0.36**	**0.072**	**0.0375**	**0.1095**

Source: County of Maui MDWS

Figure 17-22 Comparison of Growth Boundaries, 2016 Development Project List, Kuleana Parcels, Water Systems and Water Resources



Source: Maui Island Plan, Planning Department Development Projects List (projects that have come to the attention of the Planning Department), OHA Data 2009, MDWS, Water Resources & Planning.

DHHL Water Demand Projections

Water service to most existing DHHL development and facilities on Maui is currently provided by the County MDWS systems. There are no DHHL owned and operated water systems on Maui. The 2017 SWPP DHHL Update projects a demand of 117,700 gpd of potable water and

255,000 gpd of non-potable water for new projects in the Hāna ASEA. The Wākiu tract is planned as a small residential and subsistence agricultural community mauka of Hāna Highway. The MDWS Hāna Water System has one production well and a backup well within the Wākiu tract. A previously used well “Wakiu A” has been taken out of production. The 2017 SWPP states that DHHL is negotiating a water credit agreement with MDWS for all project phases in exchange for the use of DHHL land for the MDWS wells. The DHHL project phases are scheduled for completion in 2021, 2026 and 2031. The 2004 DHHL Island Plan states that the first phase can be serviced by the existing MDWS storage at Wakiu. The DHHL anticipates rainfall should be adequate for projected future non-potable agricultural use.[49]

The projections in the tables do not take into account alternate sources of water that may be available or developed. Therefore, the values in these tables should not be used to compare project water demands and available source water. There are no perennial streams nor ditch systems in the area. However, the ambient rainfall within the tract ranges from 40-inches during summer months to 120-inches during winter months, which is anticipated to be sufficient to sustain crops within the Subsistence Agriculture areas.

Table 17-30 Projected Water Demands and Strategies for DHHL Projects in Hāna ASEA, (Wākiu Tract Project Future Requirements), 2031 (mgd)

Aquifer System	Project	Potable (gpd)	Potable Strategy	Non-potable (gpd)	Non-potable Strategy
Kawaipapa	Wākiu	117,700	Water Credit Agreement MDWS (61,200 gpd); coordinate with MDWS / source not identified (56,500 gpd)	255,000	Rainfall

Source: State of Hawai`i Water Projects Plan (SWPP), May 2017 Final Report, Tables 3.7 and 4.7, Cumulative Average Day Demand (gpd).

According to the SWPP, the existing MDWS Hāna Water System lacks capacity to serve the total potable demand for the proposed Wākiu development. Currently, the MDWS Hāna Water System is able to meet the existing potable water demand of 61,200 gpd, resulting in a future unmet demand of 56,500 gpd. The future unidentified water source that will be supply the unmet demand of 56,500 gpd is expected to be located within the same hydrologic unit as current potable sources. The Wakiu development will proceed in three phases scheduled for completion in 2021, 2026 and 2031, respectively; the first phase can be serviced by the existing MDWS Hāna Water System.[50] A large proportion of the funding to provide water for these projects would be allocated to the development of new sources and infrastructure, or towards payment of a proportional cost for new source development and infrastructure expansions and connection to County MDWS water systems.

[49] State of Hawai`i Department of Hawaiian Homelands, State Water Projects Plan Update, 2017, Page 4-28.
[50] Ibid.

Table 17-31 DHHL Hāna ASEA Wakiu Long-Term Water Projection

Water Development Strategy	Cumulative Average Day Demand (MGD) – Medium Projection							
	Short-Term						Long-Term	
	2012	2013	2014	2015	2016	2021	2026	2031
COUNTY-CREDIT	0	0	0	0	0	0.0240	0.0480	0.0612
REMAIN – Maui DWS	0	0	0	0	0	0.0085	0.0085	0.0565
Total Potable	**0**	**0**	**0**	**0**	**0**	0.0325	0.0565	0.1177
None – Ambient Rainfall Irrigation	0	0	0	0	0	0	0	0.2550
Total Non-Potable	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0.2550**

SWPP, 2017 Final Report, Tables 3.7 and 4.7. Cumulative Average Day Demand (gpd)

State Water Projects Plan Water Demand Projections

State water demand projections are encompassed within the population based projections for Hāna ASEA.

MDWS Water Demand Projections

MDWS can geographically service the Hāna ASEA planned growth area between Hāna Town and Nahiku. MDWS needs are projected to be about 542,047 gpd (not including DHHL needs) by 2035. Excluding Agricultural use, Residential use accounts for the greatest demand. Although the CWRM water use category "Municipal" includes all MDWS billing classes, Figure 17-23 provides a breakdown of water consumption that closest corresponds to CWRM sub-categories and actual water use.

Figure 17-23 Projected MDWS Consumption by CWRM Category, Hāna ASEA to 2035

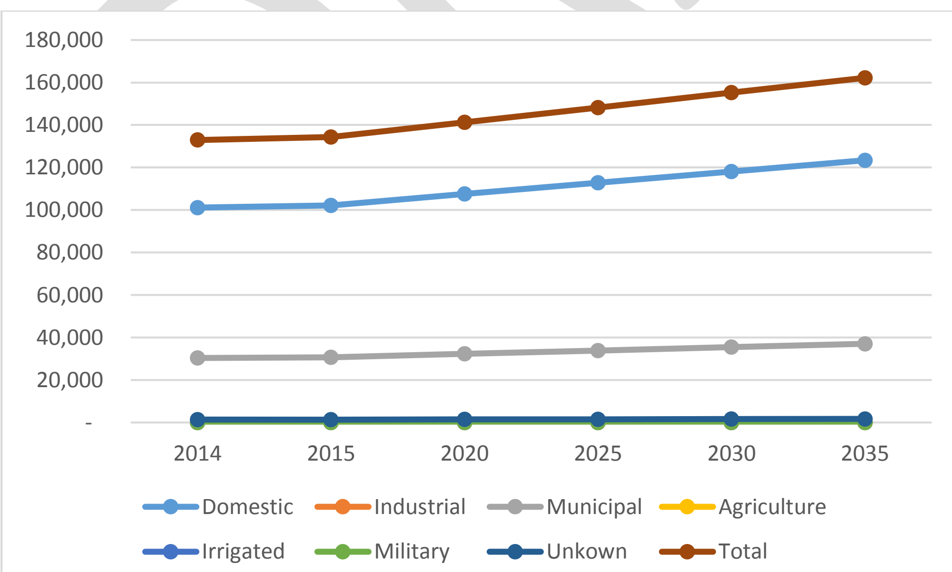


Table 17-32 Projected MDWS Consumption by CWRM Category, Hāna ASEA to 2035

CWRM Categories	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Domestic	101,152	102,212	107,513	112,814	118,115	123,416
Industrial	0	0	0	0	0	0
Municipal	30,364	30,683	32,274	33,865	35,456	37,048
Agriculture	30	30	32	33	35	37
Irrigated	0	0	0	0	0	0
Military	0	0	0	0	0	0
Unknown	1,389	1,404	1,476	1,549	1,622	1,695
Total	132,935	134,329	141,295	148,262	155,228	162,195

Source: MDWS. Based on Calendar Year 2014 consumption billing data for Nahiku 913 and Hāna 911 MDWS Water Systems.

Private Public Water Systems Demand Projections

The private public water systems were requested to provide demand projections but most did not supply information. Therefore, demand of these smaller purveyors is encompassed within the population based projections applied to Maui Island. Disclosed information is incorporated. Public water systems in the region generally do not report billed consumption but groundwater pumped. Hāna Water Resources is the largest private public water purveyor in the Hāna ASEA, producing 120,000 gpd of groundwater. Hāna Water Company reported 54,426 of groundwater production.

Other Population-Based Demand Projections

In addition to the public water systems, some persons are not served by public water systems and another component of water use is associated with population and economic demand. An unknown number of persons are not served by any public water system, but rather by wells, catchment and similar means. An estimated 'order of magnitude' demand for 2014 of 0.276 mgd was calculated and is projected to increase at a negligible rate.[53] Other population based demand includes persons using domestic wells as well as landscape irrigation and industrial wells which are not included within public system supplies. Rates of increase are based on the community plan growth rates. The Hāna ASEA may contain a high proportion of unserved population compared to other areas on Maui.

[53] 2010 Census Block Group populations that appear to be outside public purveyor service areas – approx. 1,190; apply average MDWS per capita rate of 248 gpd based on 2010-2014 consumption and interpolated population = 296,144 gpd. Excluding domestic well pumpage of 24.3 gpd results an estimated demand of 275,649 gpd.

17.6.5 Agricultural Demand Projections

As discussed under section 17.4, non-potable agricultural irrigation demand is not correlated to population growth and represents additional demand. Based on a hypothetical increase in acreage for the crops in the Crop Summary of 1% annually, projected agricultural water demand over the next 20 years would be 1,097,062 gpd, an increase of 182,843 over current estimated demand as shown below. This would represent a high growth scenario. An alternative low growth scenario would be further loss of agricultural lands to development.

A mid-growth demand scenario is that agricultural lands currently cultivated stay in production. According to the 2015 Crop Baseline, these lands are all located outside growth boundaries. However, current estimated agricultural irrigation based on reported surface water diversions (143,000 gpd) is less than irrigation demand for identified crops and acreage in the 2015 Baseline (1,220,060 gpd). Therefore, current estimated demand of 1,220,060 gpd is considered to include a high growth scenario and no further adjustment is made to account for potential increase in cultivation. It is expected that the AWUDP update will address agricultural irrigation projections in greater detail.

Table 17-33 Projected Agricultural Demand Based On 2015 Agricultural Baseline (Not Including Kuleana Parcels), Hāna ASEA 2035 (mgd)

Aquifer System	Crop Category	Estimated Acreage	Water Standard (gpd)	Estimated Average Water Use (gpd)	20% Increase in Water Demand
Kipahulu	Taro	2.56	27,500 (15-40K)	70,400	84,480.00
Kipahulu	Diversified Crop	2.01	3,400	6,834	8,200.80
Kipahulu	Commercial Forestry	33.12	4,380	145,065.60	174,078.72
Kipahulu	Banana	22.28	3,400	75,752	90,902.40
Kipahulu	Pasture*	1,463.33	0* (0-7,400)	0*	0.00
Kipahulu Sub-Total		**1,523.30**		**298,051.60**	**357,661.92**
Waiho`i	Taro	0.51	27,500 (15-40K)	14,025	16,830.00
Waiho`i	Diversified Crop	5.44	3,400	18,496	22,195.20
Waiho`i	Banana	0.36	3,400	1,224.00	1,468.80
Waiho`i	Pasture*	157.21	0* (0-7,400)	0*	0.00
Waiho`i Sub-Total		**163.52**		**33,745**	**40,494.00**
Kawaipapa	Diversified Crop	30.33	3,400	103,122	123,746.40
Kawaipapa	Tropical Fruits	47.93	10,000	479,300	575,160.00
Kawaipapa	Pasture*	2,377.50	0* (0-7,400)	0*	0.00
Kawaipapa Sub-Total		**2,455.76**		**582,422**	**698,906.40**
Kuhiwa Sub-Total	Pasture*	**159.96**	0* (0-7,400)	0*	0.00
Total		**4,142.58**		**914,218**	**1,097,062**

Source: 2015 Statewide Agricultural Baseline GIS, acreages calculated by MDWS. It is not specified whether taro is dryland or wetland. Excluded crops from the above table are the 2015 Statewide Agricultural Baseline Taro, Diversified Agriculture, and Pasture crops that intersect Kuluana parcels derived from
Estimated Water Use for taro: average wetland taro consumptive rate. Coffee: 2004 AWUDP Kaua`i Irrigation System- 2,500 gpd; 2,900 gpd reported by plantation on Oahu per Brian Kau, HDOA, personal communication, 10/12/2016, Diversified Ag-HDOA Guidelines, 2004 AWUDP
*Most pasture is not irrigated and uses no water

FFL=Flowers, Foliage, Landscape Water Use Rates: HDOA Guidelines; Coffee: 2004 AWUDP Kaua`i Irrigation System- 2500 gpd; 2900 gpd reported by plantation on Oahu per Brian Kau, HDOA, personal communication, 10/12/2016.

Table 17-34 Projected Water Use by Kuleana Parcels *also* located within 2015 Agricultural Land Use Baseline, Hāna ASEA 2035 (gpd/acre)

Aquifer System	2015 Crop Category	Kuleana Parcels Acreage	Water Standard	Est. Ave. Water Use	Projected Ave. Water Use (2035) 20% Increase
Kawaipapa	Pasture*	104.51	0* (0-7,400)	0	0
Kawaipapa	Diversified	8.30	3,400	28,220	33,864
Waiho`i	Taro	0.13	27,500	3,575	4,290
Total		**112.94**		**31,795**	**38,154**

Sources: 2015 Statewide Agricultural Land Use Baseline GIS; Kuleana parcels-OHA, 2009. Approx. agricultural acreages overlying Kuleana parcels calculated by MDWS using GIS intersection of Kuleana parcels (OHA 2009) and 2015 Agricultural Land Use Baseline data.
Water Use Rates: Diversified Ag-HDOA Guidelines; Taro-CWRM Na Wai `Eha and East Maui Streams Contested Case Hearings. Due to proximity of parcels to stream, taro is assumed to be wetland taro. Water standard for taro is average consumptive range of 15,000 to 40,000 gpa.
*Most pasture is not irrigated and uses no water

Table 17-35 Estimated Water Use by Kuleana Parcels *not* located in 2015 Agricultural Land Use Baseline, Hāna ASEA (gpd/acre)

Aquifer System	2015 Crop Category	Kuleana Parcels Acreage	Water Standard	Est. Ave. Water Use	Projected Ave. Water Use (2035) 20% Increase
Kawaipapa	Pasture*	7.95	0* (0-7,400)	0*	0*
Kawaipapa	Diversified**	0.63	3,400	2,146**	2,575**
Kawaipapa	Taro***	0.01	27,500	272***	327***
Kawaipapa Total		**8.59**		**2,418**	**2,902**
Kipahulu	Pasture*	53.46	0* (0-7,400)	0*	0*
Kipahulu	Diversified**	4.24	3,400	14,435**	17,322**
Kipahulu	Taro***	0.07	27,500	1,829***	2,195***
Kipahulu Total		**57.77**		**16,264**	**19,517**
Kuhiwa	Pasture*	6.51	0* (0-7,400)	0*	0*
Kuhiwa	Diversified**	0.52	3,400	1,757**	2,108**
Kuhiwa	Taro***	0.008	27,500	223***	267***
Kuhiwa Total		**7.038**		**1,979**	**2,375**
Waiho`i	Pasture*	30.85	0* (0-7,400)	0*	0*
Waiho`i	Diversified**	2.45	3,400	8,331	9,997
Waiho`i	Taro***	0.04	27,500	1,055	1,266
Waiho`i Total		**33.34**		**9,386**	**11,263**
Total		**106.738**		**30,047**	**36,057**

Source: Kuleana parcels-OHA, 2009. Approx. agricultural acreages overlying Kuleana parcels calculated by MDWS using GIS intersection of Kuleana (OHA 2009) and 2015 Agricultural baseline data.
Water Use Rates: Diversified Ag-HDOA Guidelines; Taro-CWRM Na Wai `Eha and East Maui Streams Contested Case Hearings. Due to proximity of parcels to stream, taro is assumed to be wetland taro. Water standard for taro is average consumptive range of 15,000 to 40,000 gpa.
*Most pasture is not irrigated and uses no water
**Diversified Agriculture not included in 2015 Agricultural Baseline data was estimated to be 7.35% of total acreage based on the ratio of Diversified to total acreage in the GIS intersection of Kuleana (OHA 2009) and 2015 Agricultural Baseline data.
***Taro crop cultivation not included in 2015 Agricultural Baseline data was estimated to be 0.12% of total acreage based on the ratio of Taro to total acreage in the GIS intersection of Kuleana parcels (OHA 2009) and 2015 Agricultural Baseline data.

Table 17-36 Summary of Projected Agricultural Water Use Analysis, Hāna ASEA

Agricultural Land Areas in Ag Water use Analysis	Estimated Water Use (gpd)	Projected 20% Increase Water Use, 2035 (gpd)
2015 Ag Baseline minus Kuleana Parcels	914,218	1,097,062
Kuleana Included in 2015 Ag Baseline Analysis (Subtracted from the Ag Baseline Total)	31,795	38,154
Kuleana not Included in 2015 Ag Baseline	30,047	36,057
1989 Declarations of Water Use	244,000	292,800
Total Estimated Agricultural Water Use	**1,220,060**	**1,464,073**

17.6.6 Irrigation Demand Projections

Landscape irrigation associated with single family homes and most commercial uses are factored into MDWS and private purveyor's municipal water use. Little information is available on end use locations of surface water diversions and it is difficult to verify that reported "diverted" water is not double counted at multiple locations. It could be argued that irrigation is not well correlated to visitor and population growth and will remain flat or decrease with water conserving design in build out. On an island-wide basis, visitor counts will increase by about 1.15 percent annually over the long term. Because de facto population (actual number of residents, non-residents and visitors) moves among the community plan regions on a daily basis, the growth in visitor units is assumed to more realistically account for growth in regional large scale irrigation, which is anticipated to be minimal within the Hāna ASEA.

The figure below illustrates the selected projected demand scenario based on population growth, in comparison to the alternative projected demand scenario based on county zoning designations. In consistency with the Maui Island Plan, the mid-growth scenario is selected to guide short term resource needs, to be adjusted as needed within the low-range to high-range projections over a 20 year time horizon. The selected demand scenario combines 20 year population growth, irrigation from surface water sources projected based on existing CWRM declarations of stream diversions, non-potable needs for Department of Hawaiian Homelands, non-potable needs for kuleana and lo`i kalo, and current irrigation demand for other agriculture from surface water sources.

Figure 17-24 Hāna ASEA Projected Population Growth and Land Use Build-Out Based Water Demand, 2015-2035

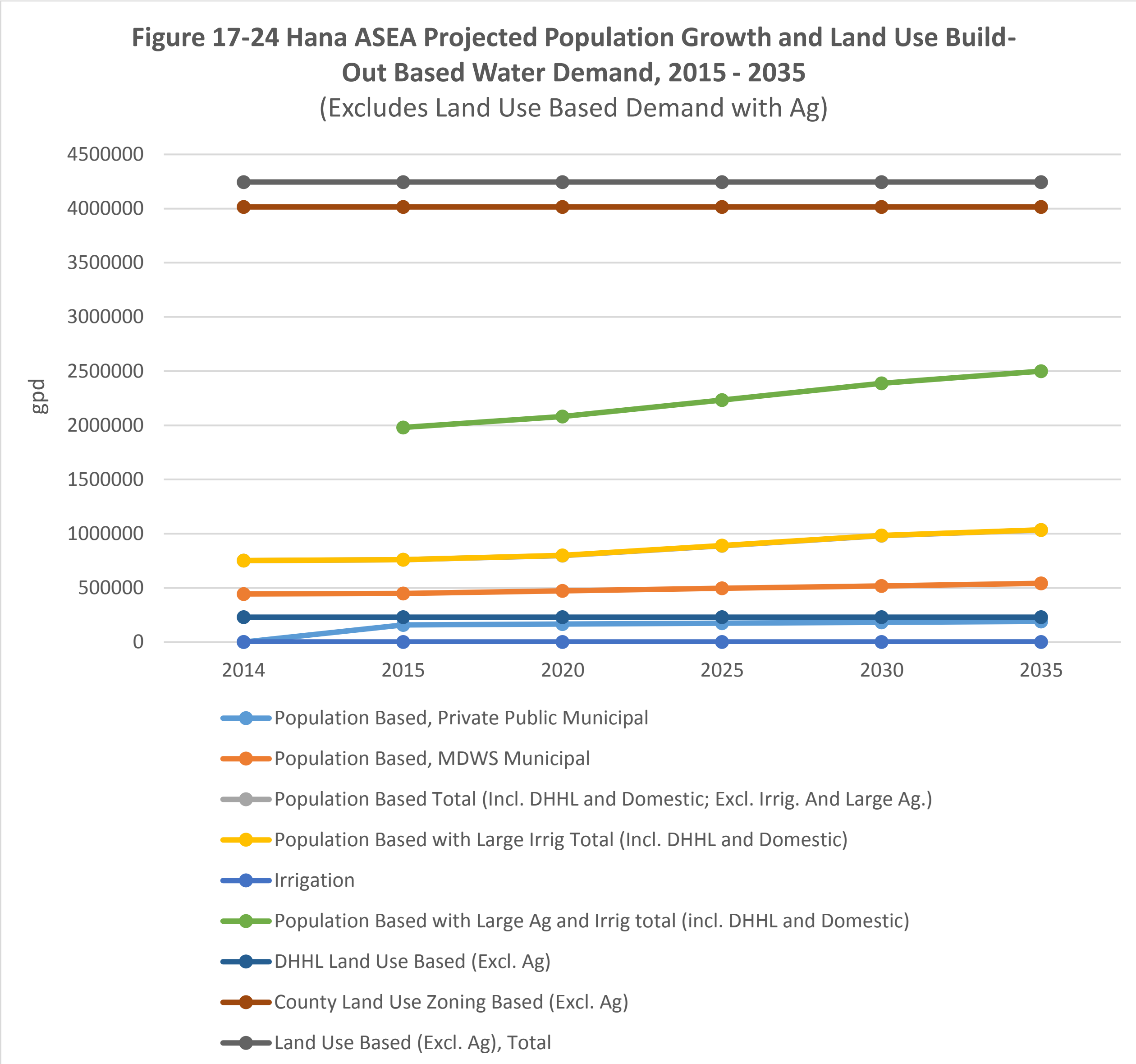


Table 17-37 Projected Water Use by Water Use Category based on Population Growth (Low, Medium and High) and Land Use Full Build-out to 2035 (gpd)

Category/ Growth Scenario	2014	2015	2016	2017	2018	2019	2020	2025	2030	2035
Population Based										
Domestic	150,667	152,246	153,825	155,404	156,983	158,562	160,141	168,037	175,933	183,828
Industrial	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Municipal DWS System**	444,264	448,920	453,577	458,233	462,889	467,546	472,202	495,483	518,765	542,047
Municipal Private PWS[54]	156,223	157,860	159,498	161,135	162,772	164,410	166,047	174,234	182,421	190,608
Military	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Subtotal Pop. Based Mid	**751,154**	**759,027**	**766,900**	**774,772**	**782,645**	**790,518**	**798,391**	**837,755**	**877,119**	**916,483**
TOTAL Mid	**751,154**	**759,027**	**766,900**	**774,772**	**782,645**	**790,518**	**798,391**	**837,755**	**877,119**	**916,483**
TOTAL Low	**751,154**	**694,130**	**701,330**	**708,529**	**715,729**	**722,929**	**730,128**	**766,127**	**802,125**	**838,124**
TOTAL High	**751,154**	**818,838**	**827,331**	**835,824**	**844,318**	**852,811**	**861,304**	**903,770**	**946,236**	**988,702**
Irrigation	1,315	1,328	1,340	1,353	1,365	1,378	1,390	1,453	1,515	1,578
DHHL[55]	0	0	0	0	0	0	0	51,700	105460	117,700
Agriculture	N/A	1,220,060	1,232,261	1,244,461	1,256,662	1,268,862	1,281,063	1,342,066	1,403,069	1,464,073 [56]
TOTAL[57]	N/A	1,980,415	2,000,501	2,020,586	2,040,672	2,060,758	2,080,844	2,232,974	2,387,163	2,499,834
Land Use Full Build-out Based[58]										
County (Zoning) (Excl. AG)	4,015,567	4,015,567	4,015,567	4,015,567	4,015,567	4,015,567	4,015,567	4,015,567	4,015,567	4,015,567
DHHL (Excl. AG)	229,700	229,700	229,700	229,700	229,700	229,700	229,700	229,700	229,700	229,700
Total, (Excl. AG)	**4,245,267**	**4,245,267**	**4,245,267**	**4,245,267**	**4,245,267**	**4,245,267**	**4,245,267**	**4,245,267**	**4,245,267**	**4,245,267**
TOTAL (Incl. AG) *not shown on chart*	65,549,545	65,549,545	65,549,545	65,549,545	65,549,545	65,549,545	65,549,545	65,549,545	65,549,545	65,549,545

[54] Based on 63,000 gpd potable use and 13,500 gpd non-potable use projection from DHHL's SWPP.
[55] Based on SWPP, 2017 Final Report, Tables 3.7 and 4.7. Cumulative Average Day Demand (gpd).
[56] Based on 20% estimated increase in agricultural water demand from 2015 to 2035.
[57] Based on Mid-Growth Projection.
[58] Land Use Full Build-Out Based analysis determined to be less accurate than Population Based analysis (above).

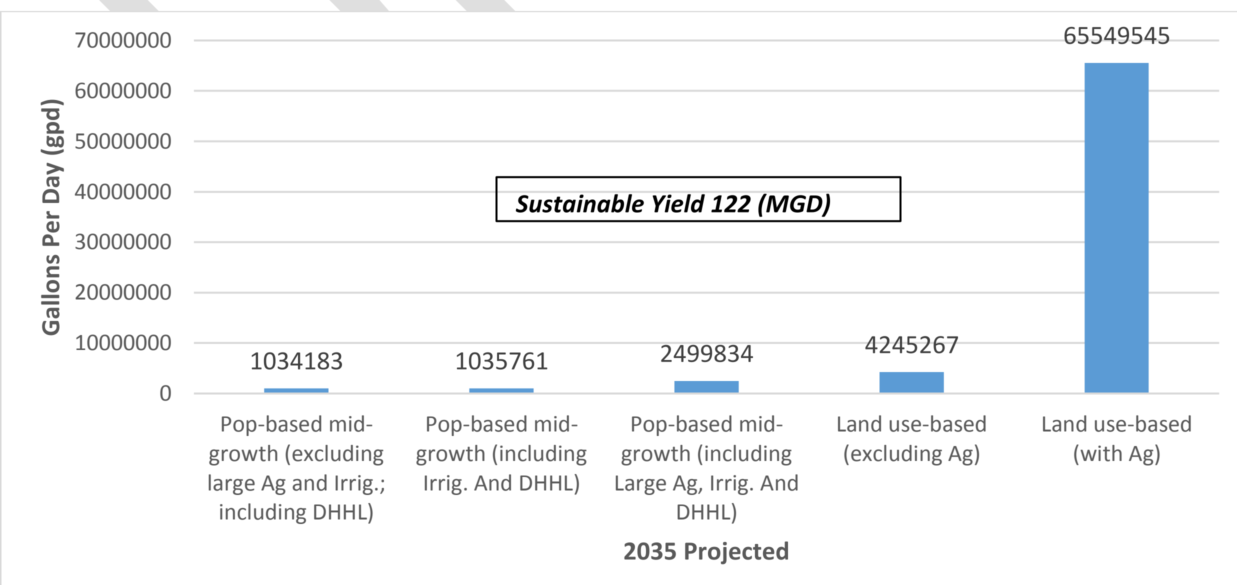
17.7 Water Source Adequacy

The analysis of available resources and projected demand confirm that there are sufficient water resources in the region to meet 20-year demand projected based on population growth under normal and drought conditions. Total pumpage reported to CWRM in 2014 (605,778 gpd) did not exceed 5 percent of regional Sustainable yield (SY) of 122 million gallons per day (mgd) for the Hāna ASEA. Groundwater SY and estimated surface water diverted of 143,000 gpd (1989 CWRM declarations of stream diversions and water use) total about 122,143,000 gpd. The SY of 122 mgd was conservatively set at the low end of the estimated range and is not expected to change in the pending update of the Water Resources Protection Plan. A hypothetical reduction in SY under long term drought conditions was assessed in response to climate change and community concerns advocating an additional buffer to groundwater development. A "drought yield" of 98.3 mgd would also provide for 2035 population growth, and agricultural demands, currently served by diverted surface water.

17.7.1 Land Use Full Build-Out Based Water Projections

Full build-out of land use classifications representing 65,549,545 gpd would not exceed the ground and surface water resources of the aquifer sector area as shown below. Excluding agriculture, land use based demand is about 4,245,267 gpd. Planning for adequate source to serve full build out demand is not supported by the Socio-Economic Forecast and could not considered a realistic and efficient use of resources. Agricultural zoned land is generally not irrigated to reflect Department of Agriculture water rate guidance for diversified agriculture. Therefore 61,304,278 gpd for agricultural production is not realistic or supported by policy and land use plans for the region.

Figure 17-25 Land Use Full Build-Out and Population Mid Growth Based Water Demand Projections, Hāna ASEA, 2035



17.7.2 Population Growth Based Water Demand Projections (20-Year)

Based on the MIP population projections, future water demand for the Hāna region is anticipated to increase from 1,980,415 gpd in 2015 (including irrigation, agriculture and DHHL) to 2,499,834 gpd by 2035, within a range of 2,421,475 (low growth) – 2,572,053 (high growth) gpd by 2035. The base case (i.e. mid-growth scenario) is selected as the most probable scenario, assuming that new housing and population growth will be focused in planned growth areas consistent with the 2014 socio-economic forecast for the region. Long-term projections are trends with expected short-term variations. Factors that especially impact growth in the Hāna region are small projects in and around Hāna Town and development of Hawaiian Homelands.[59] Water use is not exactly correlated to population and economic growth but is also impacted by climate change, type of housing development and associated irrigation. It is also expected that more aggressive conservation measures will curb water use per capita. This trend is consistent with overall island-wide decrease in water use per MDWS customer over the last ten years and continued adoption of more efficient irrigation technologies for agriculture and landscape irrigation.

The Hāna region has few visitor units, so the rates of increase in resident population will likely be higher than the rate of visitor growth, although those daily visitors who do not stay in Hāna overnight are also likely to increase. Because there is no presently reported agricultural pumpage and incomplete stream water use reported, it is not known how much agricultural water is presently being used. However, the growth in agricultural water demand within the Hāna ASEA is not anticipated to exceed the anticipated population growth of 22 % by year 2035.

[59] 2013 Socio-Economic Forecast

17.8 STRATEGIES TO MEET PLANNING OBJECTIVES

The WUDP update public process generated a set of planning objectives through an iterative process. Multiple resource options to meet planning objectives and projected demand were reviewed and evaluated in regional public meetings and workshops to assess constraints, relative costs and viability.[60] Planning objectives, preliminary strategies and related material reviewed in the final public workshop, November 17, 2016 is attached as Appendix 11. The selected strategies are presented below along with available cost estimates, hydrological, practical and legal constraints that were considered in assessing the viability of a specific resource or strategy.

Key issues identified for the Hāna community and water resources within the Hāna aquifer sector relate to watershed management and participation by the local community; maintenance of traditional resource management using the ahupua`a system and ensuring that traditional and customary practices are safe guarded. Community members state that younger generations are returning to Hāna to establish taro lo`i. Projected water demand associated with population growth is relatively modest even with an anticipated 22 percent increase in population for the Hāna Community Plan Area. Other key issues for the region focus on providing affordable water for future needs, providing for taro lo'i and other public trust uses during droughts, and managing resources in a sustainable way.

Recommended alternatives include resource management as well as development of conventional and alternative resources. All strategies are assumed to include conservation consistent with recommended supply and demand side conservation strategies outlined in Section 12.2. Implementation schedule, estimated costs and potential lead agencies, including funding sources, are summarized in Table 17-40.

[60] Preliminary Strategies for Hana Aquifer Sector November 17. 2016

17.8.1 Resource Management

Planning objectives related to resource management identified in the WUDP update public process include:

- Watershed protection and its prioritization, including invasive alien plant control, ungulate control, and reforestation via watershed partnership programs
- Maintaining access to lands for gathering, hunting and other native Hawaiian traditional and customary practices
- Improving the understanding of the concepts of "precautionary planning" to reduce and adapt to the effects of drought and climate change upon water resource availability and quality
- Consultation and coordination with Native Hawaiian community/moku and local experts on resource management and invasive species removal

The Hāna Community Plan reflects regional issues expressed at the community WUDP meetings. Policies related to water resource management include:

- Protect, preserve and increase natural marine, coastal and inland resources, encouraging comprehensive resource management programs
- Ensure that groundwater and surface water resources are preserved and maintained at capacities and levels to meet the current and future domestic, agricultural, commercial, ecological and traditional cultural demands
- Recognize residents' traditional uses of the region's natural resources which balance environmental protection and self-sufficiency
- Discourage water or land development and activities which degrade the region's existing surface and groundwater quality
- Encourage resource management programs that maintain and re-establish indigenous and endemic flora and fauna
- Protect, restore and preserve native aquatic habitats and resources within and along streams

<u>Watershed Protection and Restoration</u>

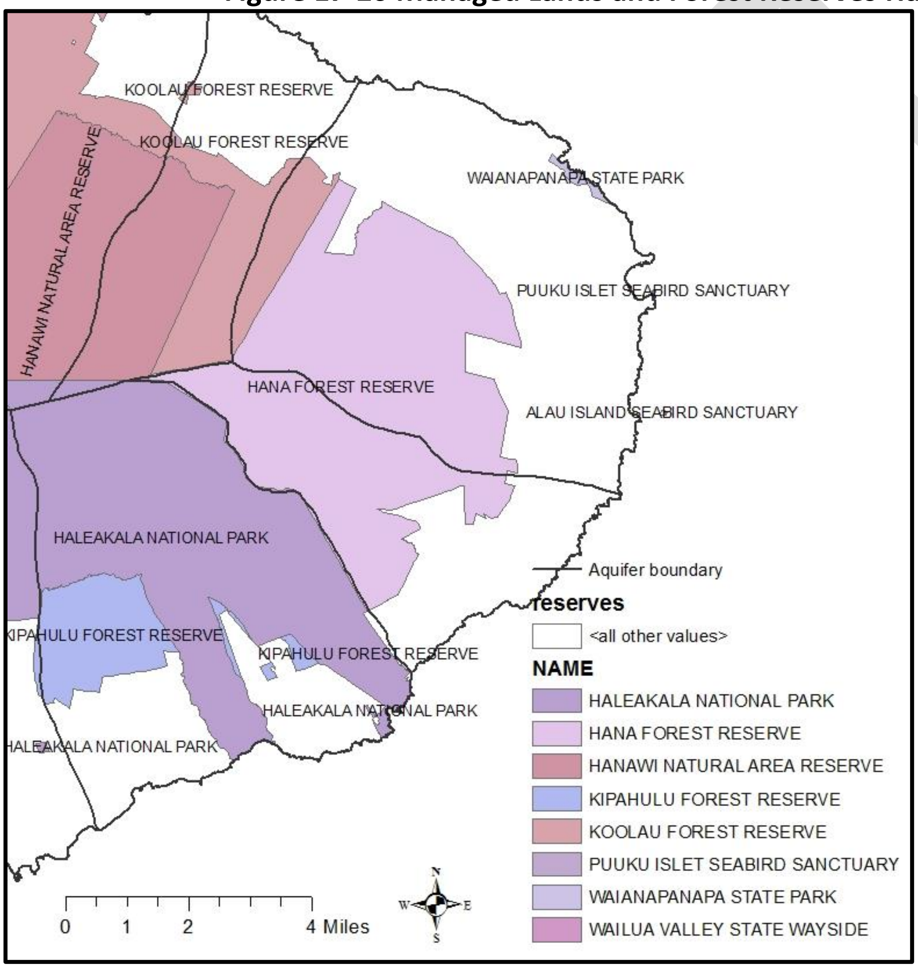
Issue and Background: East Maui watersheds are predominately vegetated by native Hawaiian rainforest. The plants there evolved over millions of years into the most efficient water collection system for our island's geography. It works in layers – tall ʻōhiʻa and koa trees provide a canopy for shorter trees, while shrubs and ferns fill in underneath, and a thick layer of mosses and leaf litter complete the floor. These layers act like a giant sponge, slowing down heavy raindrops and soaking up water for slow release into underground aquifers. Even during droughts, our watersheds can produce water, pulling water out of the clouds by collecting fog drip. This uniquely evolved, specialized forest is the key to Maui's healthy water supply. [61] The East Maui watersheds are rich in biodiversity and harbor endemic and rare native plant and bird

[61] East Maui Watershed Partnership, FY2015 Final Report to the Maui County Department of Water Supply

species. The main threats to the native forest and ecosystems are habitat loss and alterations due to feral ungulates (pigs, deer, goats) and invasive plants. These are detrimental both to biodiversity and water supply.

Hāna ASEA contains multiple watershed and forest management areas. DLNR's forest reserve systems are managed by the Division of Forestry and Wildlife (DOFAW) to protect and enhance important forested mauka lands for their abundance of public benefits and values.[62] The national park is funded and managed on a federal level. The state and federal efforts and objectives to protect native habitat and forested recharge areas benefit the county and the regional communities.

Figure 17-26 Managed Lands and Forest Reserves Hāna ASEA



Both DLNR and the National Park Service are partners of the East Maui Watershed Protection Partnership (EMWP). The partnership was the first of its kind formed in the state to work with landowners to protect native forested watersheds. The figure below illustrates the major land holdings and partners of the EMWP. The 119,000 acre watershed is a role model for proactive and effective watershed management on a large scale to ensure freshwater availability in the future. The figure below shows the extent of the partnership in the Hāna ASEA. To the south-

[62] http://dlnr.hawaii.gov/forestry/frs/

west, the Leeward Haleakala Watershed Restoration Partnership compliments watershed management and buffers the influx of invasive plant species into the national park and Kipahulu Forest Reserve.

Figure 17-27 East Maui Watershed Partnership Major Land Holdings

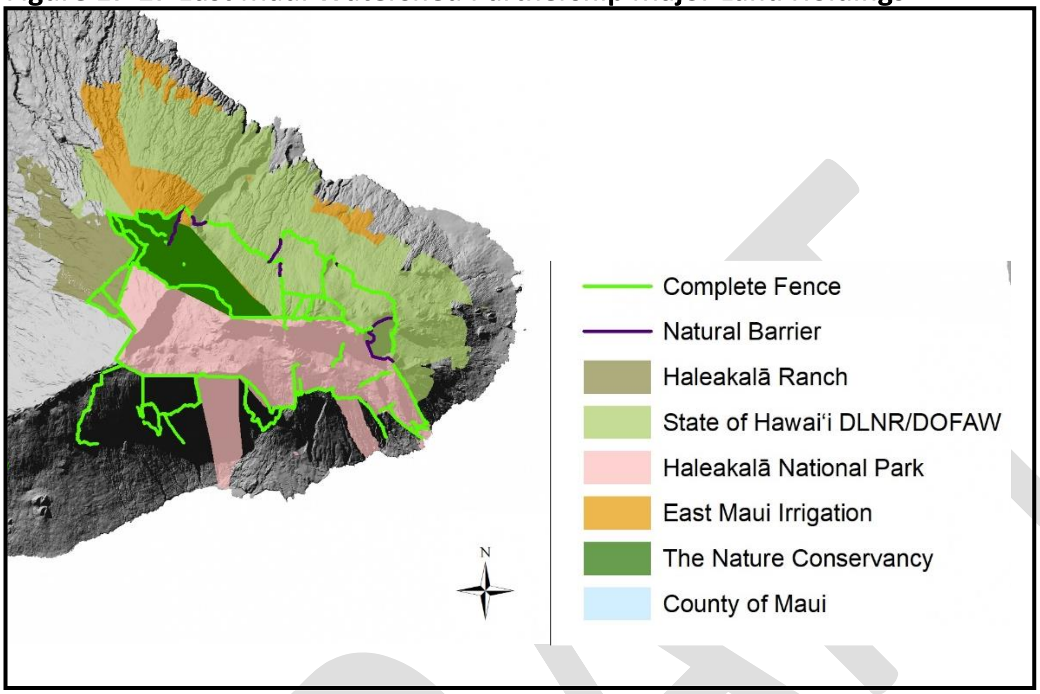
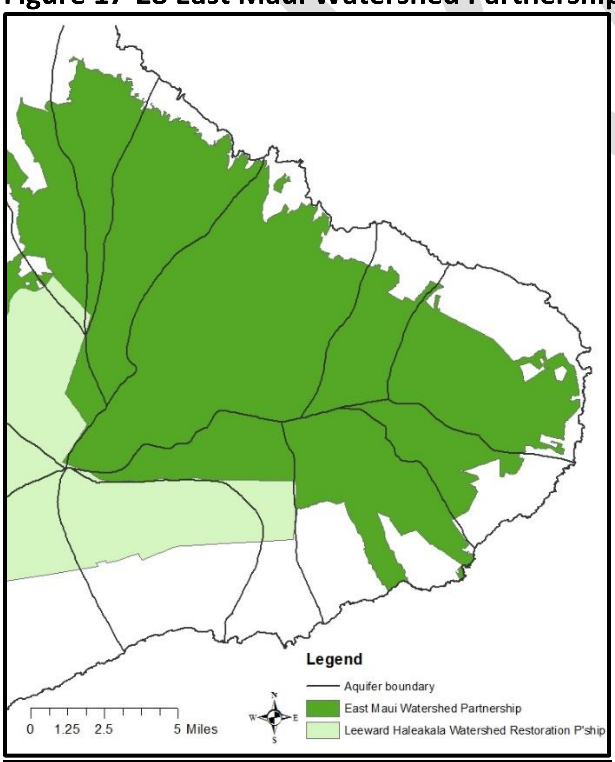


Figure 17-28 East Maui Watershed Partnership



Ongoing efforts to protect the watershed include fencing, ungulate control, invertebrate and small mammal control, weed management, rare species protection, removal of invasive species, monitoring, education, public outreach and volunteer recruitment to repair and install fencing, and plant native species. Continuous and consistent funding is paramount to maintain momentum and progress in preserving freshwater supplies and the range of ecosystem services provided by these forested watersheds.

- **Strategy #1:** Seek dedicated, long term and broad based core funding for maintaining and expanding watershed protection areas and providing for watershed maintenance in East Maui and Hāna watersheds for habitat protection and water security. The annual EMWP budget varies but have been in the range of $0.8M – $1M, with funding from Federal, State, County and private sources.

Community outreach and support is essential for sustainable resource use and protection. Sometimes fencing off areas for ungulate control create conflict with community members that seek access to hunting to maintain their subsistence lifestyle. The Hāna Community Plan policy to “Recognize residents’ traditional uses of the region’s natural resources which balance environmental protection and self-sufficiency” needs to be acknowledged and addressed. Community concerns also relate to impact from fencing on animal migration, dead animals have been reportedly ending up in streams, possibly polluting water. Watershed managers, including EMWP, the National Park Service and the DLNR Division of Forestry and Wildlife recognize that community participation and input is key to successful resource management. Although the communities and watershed managers’ objectives for resource management appear to align, concerns raised by community members in the WUDP public process tell us that improved communication and collaboration with the community is desired. The community is rich in ahupua`a based cultural and resource preservation efforts. The traditional uses of the region’s natural resources makai depend on the sustained watershed management of the mauka lands. Although not forecasted in current policy and land use plans, the cultural resurgence and repopulation of traditional lands are central to this community.

Strategy#2: Support and promote community grassroots initiatives to collaborate with state and land owner partnerships to increase participation in natural resource management and to ensure adequate access and opportunities for traditional uses of the region’s natural resources. Use established moku process to consult on resource management.

17.8.2 Conservation

Encouraging water conservation and maximizing the efficiency of water use are objectives identified in the WUDP public process as well as the 1994 Hāna Community Plan.

Qualitative criteria to evaluate and measure resource strategies against this planning objective include:

- Per capita water use decreased
- Potable and irrigation systems water loss decreased
- Community water education increased
- Incentives for water conservation increased
- Renewable energy use increased

Issue and Background: The recommended supply and demand side conservation strategies outlined in Section 12.2 apply island wide. Demand side public education and outreach benefit all water systems and end uses. Water uses per service in the county MDWS Hāna water system is low compared to other MDWS water systems or districts. Considering abundant rainfall and associated low irrigation needs this is consistent with empirical data in similar wet regions. The average water consumption per single family meter is 275 gallons per day, which is well below system standard of 600 gpd per single family unit. Customers in Hāna have also taken advantage of free low flow fixture give away opportunities and conservation educational programs when made available in the community. Current water use in the region is well below the per capita goal of 305 gpd per person set forth in the Hawaii Freshwater Blueprint.

The MDWS Hāna water system has periodically shown significant discrepancies between water produced and water billed. A water audit in 2017 revealed an apparent water loss of about 63%. Although the volume of water produced in this system is relatively small, the cumulative loss over time can be significant. However, the cause of the discrepancy is not identified and requires further investigation. An apparent water loss can be due to errors in billing data, the production flow meters, distribution system leaks, water theft and other possible causes. An investigation, including physical leak detection, is underway by MDWS to identify and resolve the disproportionate system losses. Supply side measures including water audits and leak detection programs can be implemented for small private systems as well.

18.8.3 Conventional Water Source Strategies

Conventional water sources include groundwater (wells and tunnels) and surface water (stream diversions). Region specific planning objectives related to ground and surface water use and development identified and confirmed in the WUDP update public process include:

- Improving the understanding of the concepts of "precautionary planning" to reduce and adapt to the effects of drought and climate change upon water resource availability and quality
- Adapting future populations to local water resource conditions, integrating conservation and the use of alternative resources
- Water needs of DHHL in Hāna should be considered in general and in accordance with the 2017 State Water Projects Plan

Planning objectives related to groundwater and surface water source use and development identified to apply island wide include:

- Manage water equitably
- Provide for Department of Hawaiian Homelands needs
- Provide for agricultural needs
- Protect cultural resources
- Provide adequate volume of water supply
- Maximize reliability of water service
- Minimize cost of water supply

In addition, the Hāna Community Plan identified the objective to “Improve water source and delivery facilities to ensure that water supplied to the region's residents and visitors is of the highest quality”.

Qualitative criteria to evaluate and measure resource strategies against these planning objectives include:

- Public water system water shortages to serve existing customers avoided
- Public water supply drought shortages avoided
- MDWS prioritize DHHL needs over lower priority needs
- Potable water use for non-potable needs decreased
- Contingencies in place to support water supply system functions during emergency conditions
- Water is available to serve Maui Island Plan development
- Strategies to meet all needs incorporated into WUDP

<u>**Potable Groundwater Development**</u>

Issue and Background: The Maui Island Plan addressed the MDWS system need, excluding private purveyors, irrigation and agricultural demand. The MDWS system currently receives all water from groundwater wells in the Kawaipapa aquifer. The two private water systems, Hāna Water Resources and Hāna Water Company, produces 0.156 mgd, 26% of municipal supply. The following objectives derived from the Maui Island Plan should guide groundwater development in the region:

- Provide adequate volume of water to timely serve planned growth in MIP
- Increase capacity of water systems in striving to meet the needs and balance the island's water needs
- More comprehensive approach to water resource planning to effectively protect, recharge and manage water resources
- Ensure stable chloride levels in developed wells

The MDWS system supplies the rural and country town growth areas and is assumed to absorb most of growth and associated water use. As shown in the previous sections, 2035 total potable water needs (excluding agricultural non potable irrigation totaling 1.464 mgd) is projected to about 1.036 mgd. The majority of growth is anticipated to occur within growth boundaries throughout Kawaipapa and Waiho`i aquifer systems. The MDWS service area spans from Kawaipapa to Waiho`i with 100 percent supply sourced from Kawaipapa aquifer system.

Regional groundwater can continue to provide for municipal, domestic and irrigation needs, even under drought conditions and a potential high growth scenario. Source development must account for peak use and water losses. Comparing MDWS base production for 2014 and high production months over 10 years, there is a 31 % variation. However, recognizing the current water losses and high discrepancy between production and billed consumption will be adjusted, 20% is added to average projected production to ensure adequate source capacity. This is consistent with other MDWS systems relying on groundwater source. The adjusted demand represent an additional 0.207 mgd. Total demand needed is therefore 1.243 mgd (1.036 + .207 mgd).

Installed pump capacity for the MDWS Hāna sub system, including the Wakiu and Hamoa well fields totals 1.2 mgd. To account for system standards, pumping 16 hours and the largest pump out of service, the system can provide about 0.5 mgd. Installed pump capacity for private municipal wells are adjusted to 16 hours pumpage, shown below as "Estimated Available Capacity". To meet peak demand, a modest 0.1 mgd additional source will be needed by 2035.

Table 17-38 Groundwater Source Development to Meet Population Growth Based Demand in Hāna ASEA 2035 (mgd)

Aquifer System	Installed Source Capacity	Estimated Available Capacity (16 h pumpage)	2035 Projected Demand	Source Need**	Sustainable Yield	Potential Drought Yield Conditions
Kawaipapa	2.424	1.5	0.8 – 1.1	0.1 (0.5 mgd to Waiho`i)	48	*39.4*
Kuhiwa	0.036	0.02	0.01 – 0.02	0	14	*12.5*
Waiho`i	0.069	0.04	0.07 – 0.5	(0.5 mgd from Kawaipapa)	18	*14.6*
Kipahulu	0.815	0.054	0.05 – 0.07	0	42	*34*
Total	**3.344**	**1.614**	**1.243**	**0.1**	**122**	*100.5*

*Projected demand, including DHHL and irrigation wells 1,036 mgd, adding 20 % to account for peak demand (1.243 mgd),
** Source need is projected demand less developed source capacity for region
Source: MDWS Water Resources & Planning Division, 2017

Optimization studies have not been performed for the MDWS Hāna water system. A source development analysis is therefore needed. The analysis should address costs of infrastructure improvements needed to meet system standards. It's possible that a combination of low growth, aggressive conservation and increased production efficiencies will avoid the need to develop source over the planning period.

Strategy #3: Complete optimization studies/source development analysis for the MDWS Hāna subsystem (PWS 217) in order to assess basal well development needs by 2025. Costs of regional well development have not been assessed but is comparable to 20 year life cycle costs estimated for Haiku/Central well development at $3.55 per 1,000 gallons.

<u>**Department of Hawaiian Homelands Wakiu Tract Build Out**</u>

Issue and Background: The 2017 State Water Projects Plan Update for DHHL projects a demand of 117,700 gpd of potable water and 255,000 gpd of non-potable water for new projects in the Hāna ASEA. The 2017 SWPP states that DHHL is negotiating a water credit agreement with MDWS for all project phases in exchange for the use of DHHL land for the MDWS wells. As a technical matter, it is MDWS policy that issuance of water credits is generally not an appropriate direct compensation for use of land, but rather cooperative source development/funding arrangements. DHHL potable demand is accounted for in the demand projections and source development needs above. Available capacity can currently serve the project potable needs. However, remaining capacity must be reassessed for DHHL scheduled project phases 2021 – 2031. Sustainable yield of the Kawaipapa aquifer can support new source development, whether private or collaboratively with MDWS.

DHHL non potable needs of 255,000 gpd can be sustained by ambient rainfall within the tract, ranging from 40-inches during summer months to 120-inches during winter months. This is the non potable strategy recommended in the SWPP update.

<u>Nahiku Water Service</u>

Issue and Background: MDWS supplies about 40 meters along Nahiku Road, which runs along the boundary of Kuhiwa aquifer system in Hāna ASEA and Keanae aquifer system in the Ko`olau ASEA. MDWS purchases water for domestic supply from the East Maui Irrigation (EMI) Company's West Makapipi Tunnel 2. The source is known as "Nahiku tunnel". A Memorandum of Understanding allows DWS to take up to 20,000 gpd.

There are Nahiku residents close to the county system that are not able to connect due to cost of extending the line. There is one irrigation well and no identified domestic wells on the Hāna ASEA side of Nahiku. The Kuhiwa well, owned by Maui Land & Pineapple Company is classified as Agricultural. It is unclear whether portions and what portions of the community are possibly served by the Kuhiwa well. It was stated that 60 – 100 families in the Makapipi area are without water and have to haul it in or have it hauled in. There were also concerns that lack of water in Makapipi stream affects local springs on which people depend for their water.

Extending MDWS service area by installation of new mains and laterals are subject to MDWS rules and the cost borne by the meter applicant. Based on water use on the Nahiku system, there is sufficient source to accept new meter service applications. Currently the Water System Development Fee (WSDF) is set by meter size and does not differentiate by service area or customer class. Therefore new customers that apply for water service in an area with adequate source, storage and transmission helps pay for water service in areas that require source and infrastructure development to take on new customers. Input during the WUDP update public process indicated that the current WSDF structure supports equity (growth pay for growth, districts share burden equally) rather than recommending an overhaul to the WSDF structure.

<u>Non Potable Surface Water Use and Development</u>

Issue and Background: Surface water is diverted for a variety of purposes; however, surface water diversion data reported to CWRM for the Hāna ASEA is very limited, other than the 1989 Declarations of Water Use already described in this report. There are no CWRM stream diversion gages located within the Hāna ASEA. Because there are no existing or proposed diversions to convey surface water out of Hāna ASEA or for other purposes than regional domestic and agricultural needs, studies of stream flow and establishing numerical instream flow standards have not been urged. Nevertheless, the community has raised concerns over sufficient stream flow to support taro (lo`i Kalo), droughts and climate change impacts, potential new diversions and compliance with the Public Trust Doctrine.

Mauka to makai stream flow is at the core of the traditional and self-sufficient Native Hawaiian livelihood of the region. Although there are no known competing needs for surface water diversions in the Hāna ASEA, stream flow data, especially during dry conditions is needed to assess long term adequate inflow for healthy lo`i Kalo and any impact on stream life and the near coastal environment. It's therefore recommended that CWRM undertake streamflow studies and establish numerical IFS over the planning period.

Strategy #4: The Commission on Water Resource Management to establish Instream Flow Standards on a stream-by-stream basis to protect the public interests of the Hāna aquifer sector. Recognizing that other regions with competing off-stream needs must be prioritized, this strategy is proposed as a medium to long term implementation time frame.

<u>Providing for Non Potable Agricultural Needs</u>

Historically and currently, Hāna is known for its agricultural food productivity. As discussed under section 11.4, non-potable agricultural irrigation demand is not correlated to population growth and represents additional demand. No inventory exists of irrigation versus reliance on ambient rainfall in the region. Current estimated agricultural irrigation based on reported surface water diversions far exceeds irrigation demand calculated by applying a water use coefficient for identified crops and acreage in the 2015 Crop Baseline. Pasture land is not currently irrigated, it is possible that more intensive use such as grass-fed livestock would merit irrigation. No agricultural well pumpage is reported but could potentially supply future crops from existing installed or new agricultural production wells.

Because stream flow is not gaged it's difficult to assess whether available surface water can sustain projected agricultural needs. Anecdotal information of locally inadequate stream flow must be addressed in Strategy #4 above.

<u>Climate Adaptation</u>

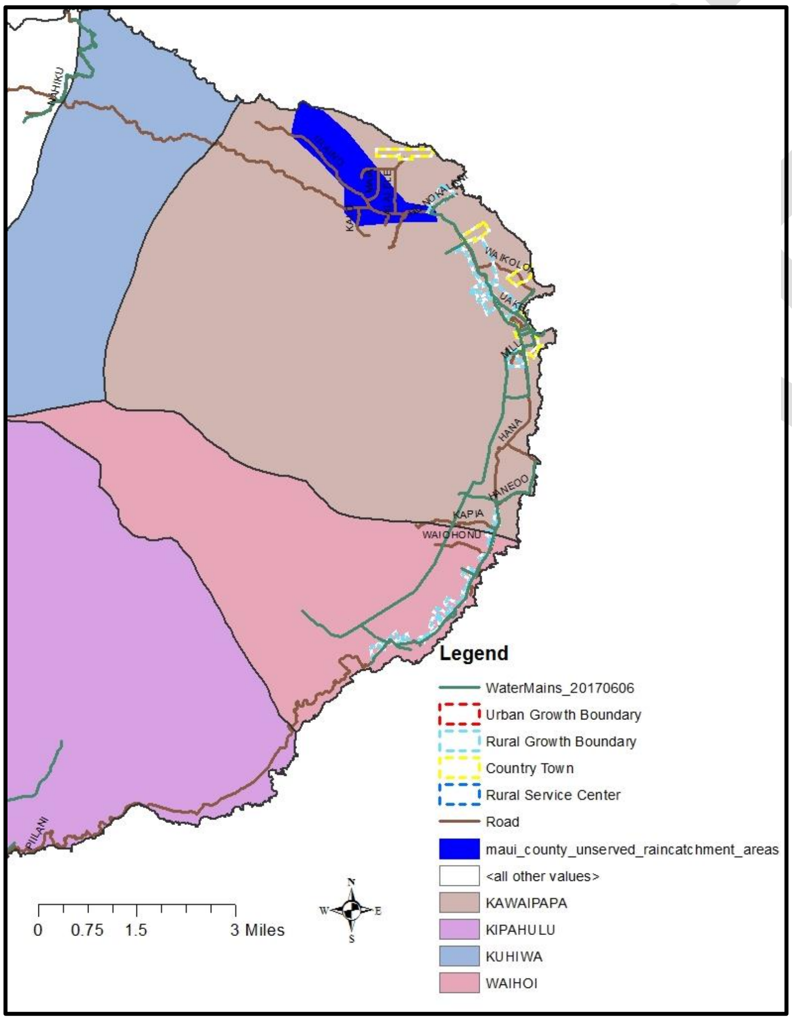
Issue and Background: Data and research suggest that Hawai'i should be prepared for a future with a warmer climate, diminishing rainfall, declining stream base flows, decreasing groundwater recharge and storage, and increased coastal groundwater salinity, among other impacts associated with drought.

No streamflow projections are available for the coming century but projections include a decline in base flow and low flows, with stream flows becoming more variable and unstable (flashy), especially in wet years. [63] The impact on groundwater recharge will vary locally. A 2017 update to the Hawaii Drought Plan includes traditional and customary rights and practices as those potentially impacted by droughts. Reduced rainfall and streamflow reduce available water for domestic uses and irrigation, and degrading aquatic habitats where stream flora and fauna are gathered. Reduced stream flow may impact other cultural and religious practices, and terrestrial plants causing water stress.

[63] Summarized from EcoAdapt. 2016. Climate Changes and Trends for Maui, Lāna'i, and Kaho'olawe. Prepared for the Hawaiian Islands Climate Synthesis Project

Drought risk and vulnerability are assessed by the CWRM to illustrate the spatial extent and severity of drought risk for different impact sectors throughout the state. The statewide "*Drought Risk and Vulnerability Assessment and GIS Mapping Project"* assesses drought risk areas for three impact sectors: 1. water supply; 2. agriculture; and 3. wildland fire. Hāna is identified at moderate risk for water supply. [64] Areas served by groundwater have a lower risk of drought impacts. Communities that are supplied by surface water have a medium drought risk as most have storage capacity to carry them through short term declines in rainfall. The most vulnerable to drought are those households relying solely on rainwater catchment. The map below show the general area within Hāna region that is not serviced by municipal supply or other known domestic sources and therefore more reliant on catchment systems.

Figure 17-29 Hāna ASEA, Water Supply Drought Risk Area



[64] Wilson Okamoto Corp, County of Maui Drought Mitigation Strategies, 2012 Update

No specific drought mitigation strategies are developed for this region. However, the 2017 update proposes general drought response and mitigation actions that apply state-wide. Recommended mitigation actions that apply for Hāna region include the following:

- Expand current network of rain gages to improve rainfall monitoring.
- Establish contingency water-hauling programs for livestock.
- Identify areas at risk to drought and plan for regional response actions and strategies.
- Develop additional storage and/or alternative sources of water supply.
- Develop and implement drought-related public awareness programs.
- Develop incentive programs for drought- resistant practices.

Strategy #5: Similar to other island sectors deemed at moderate to high risk of drought, convene sector-based drought workshops to assist stakeholders in developing or improving their individual drought/water conservation plans. Focus in the Hāna sector should be on catchment systems and contingency supply to supplement or substitute catchment when necessary. Cost estimate for other Maui sectors was about $50,000 with CWRM as proposed lead agency. It's recommended that CWRM with participation by MDWS and DOH (which regulates catchment systems) convene regional workshops as part of continuous updates of the State Water Plan.

17.8.3 Alternative Water Source Strategies

The Hāna Community Plan does not specifically address alternative water sources, such as graywater, catchment systems or stormwater capture. Surveys and input from the Hāna community as part of the WUDP update revealed strong support for the island-wide alternative resource strategies (WUDP Part II, Chapter 11.2), including increased stormwater reuse and recycled water use. Opportunities for exploring and adopting available alternative source options are discussed below but no strategies for implementation are proposed for water purveyors in the region.

Rainwater Catchment

Rainwater catchment is the collection of rainwater from a roof or other surface before it reaches the ground. Rainfall is sufficient throughout most of the aquifer sector to support traditional catchment systems. As discussed above, catchment systems are still vulnerable to drought conditions. Another issue is compromised water quality due to flawed design, wear and tear with no regulatory oversight once constructed. The recommended strategy above to convene workshops in East Maui to address catchment systems is also an opportunity for public education on proper design and maintenance to ensure safe water quality.

Recycled Wastewater

There is no wastewater reclamation in the Hāna region. Homes are served by septic systems and cesspools.

Stormwater Reuse

There are no large scale stormwater reclamation projects identified for Hāna. Stormwater reuse at the parcel scale may provide an opportunity to offset landscape agricultural uses within the region.

Desalination

Desalination is not feasible as alternative source as sufficient rainfall, ground and surface water resources are available.

17.8 Recommendations

Hāna is endowed with plentiful ground and surface water resources. As in ancient times, it's well known for its abundance of water and food. The challenge is to sustain and protect these natural resources that also traditional and cultural practices depend upon. The island wide strategies that address water quality (wellhead protection and well siting), conservation and energy efficiency measures will benefit the Hāna region and support the statewide initiatives to increase water security over the next decades.

Projected water demands based on the selected scenario and source strategies are summarized in the table below.

Table 17-39 Hāna ASEA Selected Demand Scenario: Projected Water Demand and Supply Options

DEMAND (GPD)	2015	2020	2025	2030	2035
MDWS Potable	448,920	472,202	495,483	518,765	542,047
Municipal Private Potable	157,860	166,047	174,234	182,421	190,608
DHHL Potable	0	0	51,700	105460	117,700
Domestic Potable	152,246	160,141	168,037	175,933	183,828
Total Potable:	**759,027**	**798,391**	**837,755**	**877,119**	**916,483**
Irrigation Non Potable	1,328	1,390	1,453	1,515	1,578
Agriculture, Non Potable	1,220,060	1,281,063	1,342,066	1,403,069	1,464,073
DHHL, Non Potable	0	0	0	0	255,000
Total Non-Potable	**1,221.388**	**1,282,453**	**1,343,519**	**1,404,584**	**1,720,651**
TOTAL DEMAND	**2,000,501**	**2,080,844**	**2,232,974**	**2,387,163**	**2,754,834**
SUPPLY (GPD)					
Potable Groundwater	**759,027**	**798,391**	**837,755**	**877,119**	**916,483**
Non Potable Groundwater	1,328	1,390	1,453	1,515	1,578
Non potable surface water	1,220,060	1,281,063	1,342,066	1,403,069	1,464,073
Ambient rainfall	0	0	0	0	255,000
TOTAL SUPPLY	**220,849**	**299,436**	**301,624**	**303,915**	**306,340**

The recommended strategies for the Hāna aquifer sector address the goals and objectives identified in the Hāna Community Plan and the WUDP public process for the region that evolve around resource protection and management; traditional uses of the region's natural resources and self-sufficiency.

Table 17-40 summarizes recommended strategies and indicates the planning objectives that each strategy supports. Estimated costs are, unless indicated otherwise, life cycle costs for the twenty-year planning period per 1,000 gallons. Life cycle costs include capital, operational and maintenance costs and include inflationary effects. The cost to develop and implement sustainability projects can be difficult to quantify per volume water supply. Lead agency, or organization to implement a strategy is proposed as a starting point. The timeframe for implementation is indicated as short term – less than 5 years, and long term 5 – 20 years. Many strategies are multi-year actions with implementation beginning within 5 years and continuing through the long term (indicated as 1, 2).

Table 17-40 Summary of Recommended Strategies Hāna ASEA

	STRATEGY	PLANNING OBJECTIVES	ESTIMATED COST	IMPLEMENTATION 1: Short-term 1 – 5 years 2: Long-term 5 – 20 years AGENCY	TIME-FRAME
	RESOURCE MANAGEMENT				
1.	Seek dedicated, long term and broad based core funding for maintaining and expanding watershed protection areas and providing for watershed maintenance in East Maui and Hāna watersheds for habitat protection and water security. The annual EMWP budget varies but have been in the range of, with funding from Federal, State, County and private sources.	Maintain sustainable resources Protect water resources Protect and restore streams	$0.8M – $1M per year	MDWS Maui County CWRM DLNR	1
2.	Support and promote community grassroots initiatives to collaborate with state and land owner partnerships to increase participation in natural resource management and to ensure adequate access and opportunities for traditional uses of the region's natural resources. Use established moku process to consult on resource management	Maintain sustainable resources Protect water resources Protect and restore streams	N/A	Public-private partnerships Aha Moku DLNR Maui County	1
	CONVENTIONAL WATER SOURCE STRATEGIES				
3.	Complete optimization studies/source development analysis for the MDWS Hāna subsystem (PWS 217) in order to assess basal well development needs by 2025. Costs of regional well development have not been assessed but is comparable to 20 year life cycle costs estimated for Haiku/Central well development	Provide adequate volume of water supply Maximize reliability of water service Minimize adverse environmental impacts Provide for DHHL needs	$3.55 per 1,000 gallons	MDWS DHHL	2
4.	The Commission on Water Resource Management to establish Instream Flow Standards on a stream-by-stream basis to protect the public interests of the Hāna aquifer sector. Recognizing that other regions with competing off-stream needs must be prioritized, this strategy is proposed as a medium to long term implementation time frame.	Protect and restore streams Protect cultural resources Maintain sustainable resources Protect water resources	N/A	CWRM USGS	2

5.	Convene sector-based drought workshops to assist stakeholders in developing or improving their individual drought/water conservation plans. Focus in the Hāna sector should be on catchment systems and contingency supply to supplement or substitute catchment when necessary.		$50,000	MDWS CWRM DOH	2

17.9.1 Implementation Program

In consistency with the Maui Island Plan, strategies recommended and adopted in the WUDP does not legally bind the agencies and organizations to execute. The recommendations provide guidance for land use and infrastructure, including the county CIP program, over the planning period.

Timing and prioritizing of resource strategies, particularly groundwater development are tied to actual population growth in this region. Prioritizing resource management and seeking guidance from the resourceful and knowledgeable community is key to sustain the traditional lifestyle and sense of place.

Over the planning period, implementation and performance of the recommended strategies can be assessed using qualitative criteria and quantitative targets formulated in the WUDP Part I, Table 3-3.

LIST OF TABLES AND FIGURES